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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.

Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

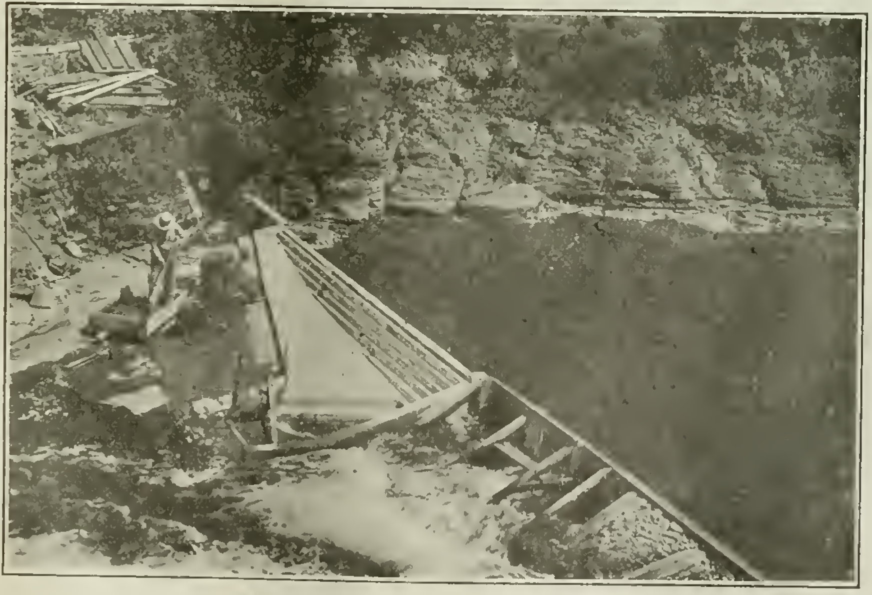
Vol. 51 . JULY 2, 1921 No. 1

Building the Gilboa Dam

This dam across the Schoharie river is a part of the Schoharie development of the Catskill water supply of New York City, the tunnel part of which was described in our issues of June 4 and 11. The study of the design of the dam section was unusually exhaustive.

In a previous article we described the construction of the Shandaken tunnel which is to form part of New York's Catskill water supply and in connection with this, told of the part that the Schoharie river and reservoir and the Gilboa dam are to play in this Schoharie development. In this article we will describe some of the more interesting features of this reservoir and dam.

The reservoir will have a water surface area of 1,170 acres. Its length will be 5.8 miles, its maximum width 0.7 miles, its average width 0.3 miles, its maximum depth 140 feet and its average depth 57 feet.



MODEL OF DAM AND SPILLWAY, ONE-FIFTIETH ACTUAL SIZE

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The Schoharie water shed above the Gilboa dam contains 314 square miles, the rain-fall on which since 1907 has averaged about 40 inches a year. The average yearly flow of Schoharie creek at Gilboa is about 150,000,000,000 gallons. The Schoharie reservoir will furnish storage of about 22,000,000,000 gallons. The reservoir basin is flat for some distance above the dam so that, although the intake shaft is three miles above the dam, only about 2,000,000,000 gallons of water between it and the dam will be unavailable. The dam will have a total length of 2,300 feet, of which 1,300 feet will be spillway and the remainder will be of earth with a concrete core. The maximum height of the dam will be 160 feet. The top width of the masonry portion will be 15 feet and of the earth portion will be 34 feet; while the maximum width of base of the masonry portion will be 165 feet and of the earth portion 445 feet. The total masonry will amount to approximately 436,000 cubic yards and the total embankment to 617,000 cubic yards. There will be about 90,000 cubic yards of rock excavation and 296,000 cubic yards of earth excavation. As explained in the previous article, this reservoir is for diverting the stream into the tunnel and furnishes storage only to the extent necessary for equalizing the stream flow.

The location of the dam was determined largely by geological conditions, which were ascertained

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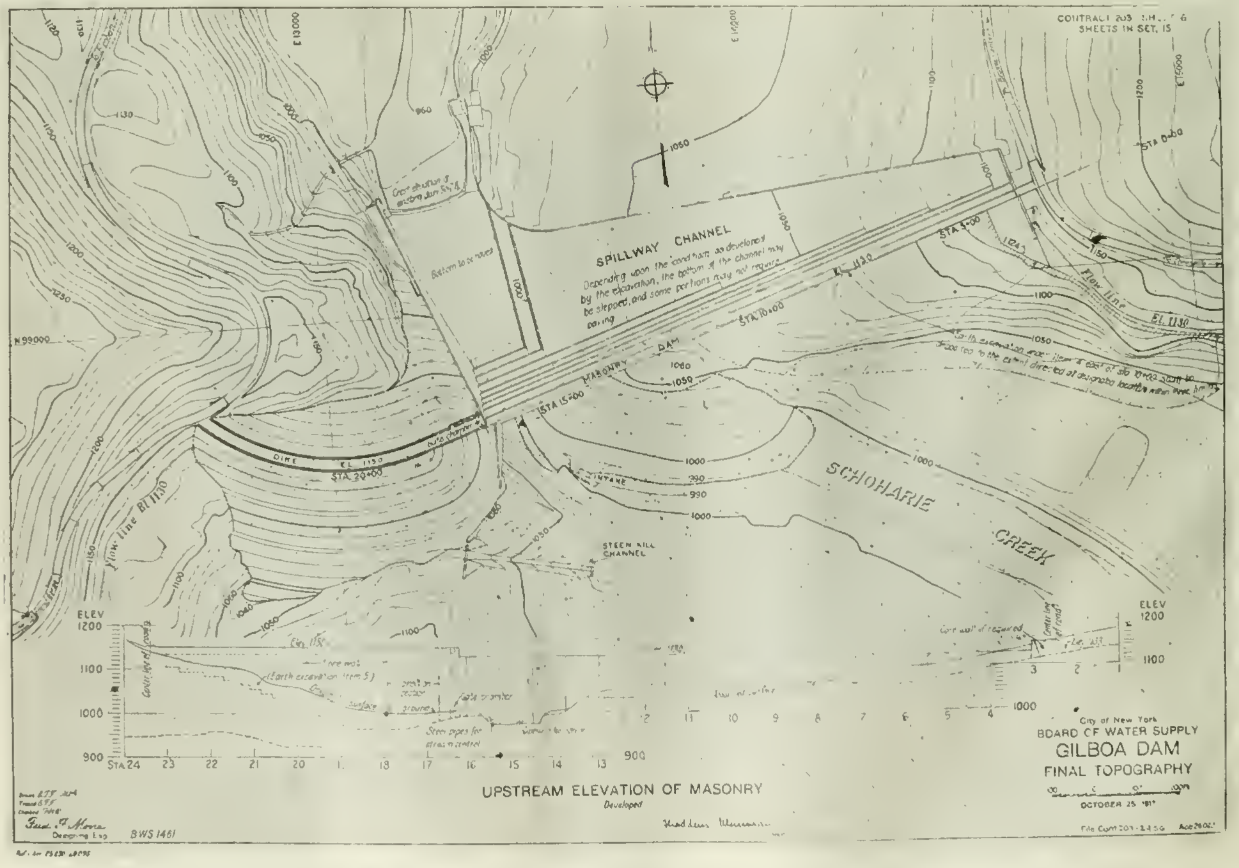
by borings and other investigations of the geological features of several sites that suggested themselves by the surface topography; this being the furthest down-stream of the three or four sites considered. At this site the conditions as to rock for foundations seemed very favorable, the preglacial gorge of Schoharie creek being filled with tight material and being deeply covered by the terraces west of the dam site.

This location of the dam was unfortunate in one respect, in that it involved the flooding of the entire town of Gilboa, which in 1917 contained a population of 325. Several cemeteries had to be removed containing 1,330 bodies. A number of residences were moved by the contractor onto the site selected for his camp and used as houses for a number of the men employed on the work, for offices, etc., while a church is used as a storehouse. The contractor (who is a Bostonian) has named the "street" on which these camp buildings face "Commonwealth avenue." The contractor is the Hugh Nawn Contracting Company. The amount of the contract was $6,819,910. Construction work was begun by the contractor July 10, 1919, and it is expected that the work will be completed by the end of 1924.

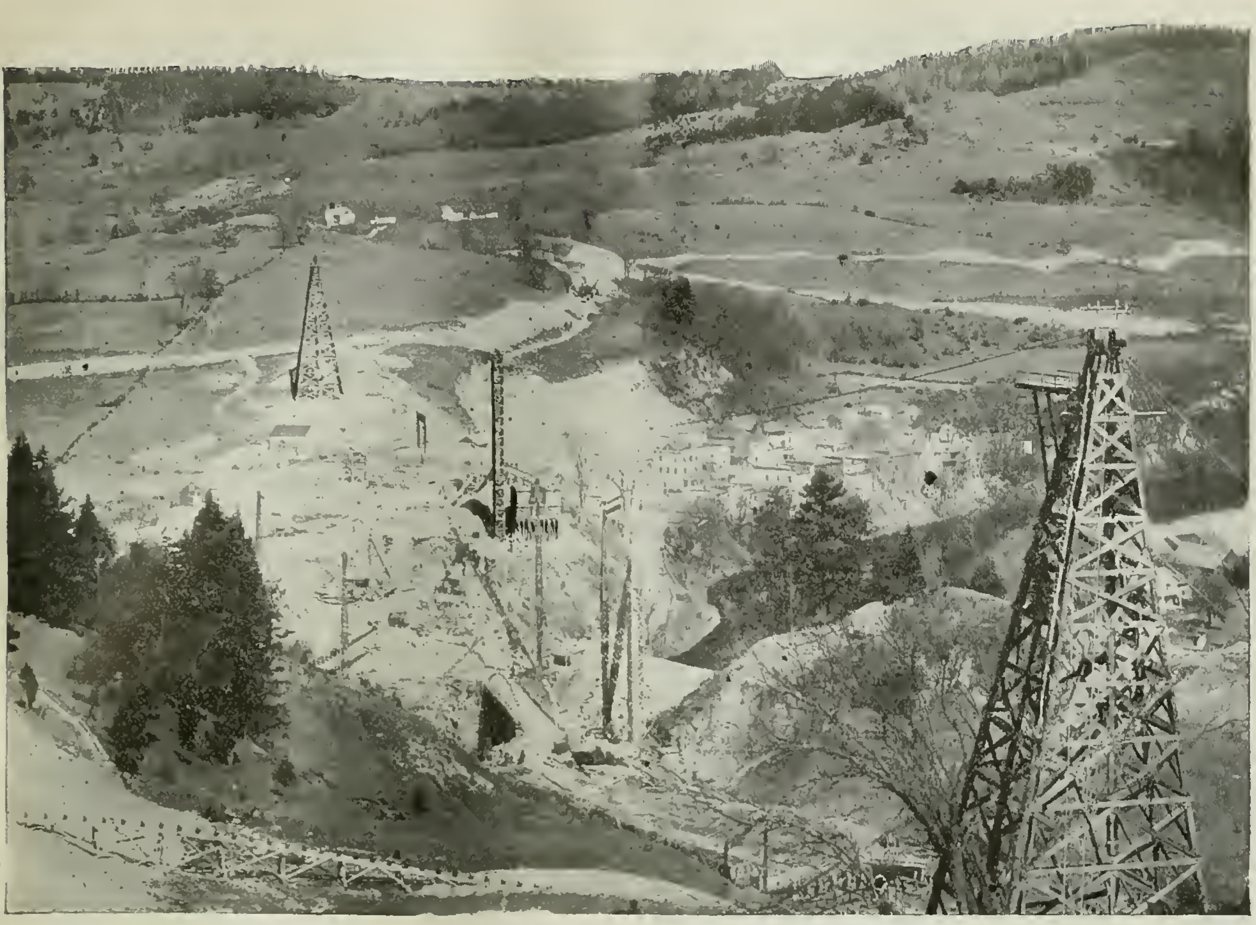
THE DAM SECTION

In determining the shape of cross section of the dam, much thought and study was given to securing a section that would minimize the velocity of the water overflowing the weir section (which constitutes about 65 per cent of the length of the dam), so as to avoid the dangers and objectionable features resulting from high velocities of large flood flows. The section finally adopted was that described as an overflow stepped weir.

In making the study for this dam, models were constructed on a small creek in the vicinity, made to scales of ⅛, 1/20 and 1/50 of the dimensions of the dam itself. These were placed side by side and water allowed to flow over them under control so that any desired depth on the crest could be obtained. Various types of gages were employed for measuring the depth on the crest and various dimensions of both treads and risers were tried for the steps in the face of the dam. The object aimed at was to secure such a cross section that, at the various heads that probably would occur over the crest of the Gilboa dam and especially at the maximum heads, the largest possible amount of energy of water would be used up before it reached the spillway channel in front of the dam. The accompanying photographs show the models of short sections of the dam built to the three different scales, with water flowing over them, and also a model of the entire dam and spillway on a scale of 1 to 50. It will be noted from these photographs that a series of diagonal vanes placed on the top step of the cross section serve to deflect the water and at the same time impart



TOPOGRAPHICAL MAP OF DAM SITE, SHOWING DAM AND SPILLWAY CHANNEL
Steen Kill flows northeast at the lower left-hand corner, entering Schoharie Creek at the site of the west end of the dam. Of the cableway towers in the general view of the dam, one is near the east end of the dam; the other is in a continuation of the axis of the masonry dam to the S. W., near the word "Elev."



GENERAL VIEW OF DAM SITE AND PLANT

Towers of cableway in fore and background. Concrete mixer and tower in center. Belt conveyor carrying embankment material at lower left corner

to it a rotary motion. The result is to check the forward velocity and to cause the water to follow down the dam profile instead of leaping clear of the upper steps as it would do in the absence of the vanes. These vanes are placed below the crest level and therefore will offer no obstruction to the passage of ice or drift wood.

To the construction of the masonry, also, considerable thought was devoted, and it was finally decided to make the body of the dam of concrete cyclopean masonry but to face it with stone laid practically as uncoursed ashler. A small section of the dam to full scale, consisting of two treads and one riser about 18 feet long was built for the purpose of showing to intending bidders the kind of masonry which was called for by the specifications. This sample is to remain until the dam has been completed in order that it may be referred to in case of dispute concerning masonry construction.

LOCATION OF DAM

The location of the dam is somewhat peculiar in plan, in that it extends across the main valley of the Schoharie from a high hill on the east side and follows up the bed of a tributary creek on the west side, finally curving to the north in order to reach the higher land. This tributary creek now enters the Schoharie at about the end of the masonry section of the dam but will be diverted into the reservoir after the dam has been completed. The plan reproduced herewith shows the location and dimensions of the spillway channel and the pool at the west end of the masonry dam. At the time the writer visited the site, a large part of the excavation for the dam down to solid bed rock had been completed and a cut-off wall was being excavated 15 feet wide and to extend about 20 feet deep near the upper face of the dam. This was being excavated by means of Ingersoll-Rand channelers and was in very hard shale.

TEMPORARY CONSTRUCTION FEATURES

The presence of the small creek coming in from the west necessitated special construction for handling its waters while building the core wall and embankment. A temporary concrete culvert has been built which will carry the stream through this dike during a part of the construction. The culvert does not extend through the entire width of the dike, but only under its central part, and when the embankment has been carried up about 30 feet, at which elevation the stream can be carried across a tongue of land into the valley of the Schoharie creek above the line of the main dam, the culvert will be filled and the embankment widened beyond it at each end. Several pipes are built into the roof of the culvert and will extend to the top of the completed embankment. Through

SAMPLE OF DAM MASONRY BUILT BEFORE BIDS WERE RECEIVED

them the culvert will be filled with sluiced material so as to thoroughly seal and fill it. In addition to this, as the embankment extends considerably beyond the ends of the culvert, there seems to be no possibility of the surface of the culvert furnishing a water channel through the embankment.

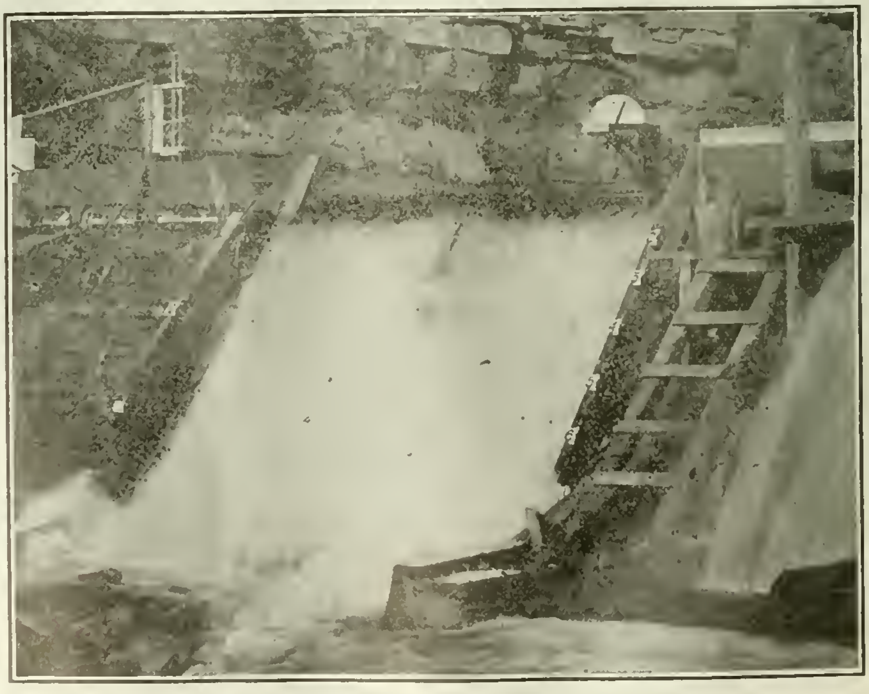
While constructing the masonry portion of the dam, the Schoharie creek is carried across the site of the dam by means of a pair of steel pipes each 10 feet in diameter, the upper ends of which are built into a cofferdam which was completed first in order to protect the work of constructing the dam. These pipes are provided with exterior circumferential angle iron flanges so as to give greater strength to resist the beam loads to which they will be subjected when flowing full. Special pains were taken with the upstream openings into these pipes through the cofferdam, forms being carefully made so as to give a bell-mouth opening in the upstream face of the cofferdam. These pipes will carry the flow of the creek except in times of extraordinary floods, which will overtop the cofferdam, which, however, is not expected to happen except a few times each year, during the larger freshets. As soon as the masonry of the dam section has been built above the level of these pipes they will be removed and the water will thereafter pass through the stream control opening which will be left as a tunnel through the masonry of the dam. This opening will be closed as a final operation during the dry season of the year and the water will then begin to fill the reservoir.

CONTRACTOR'S PLANT

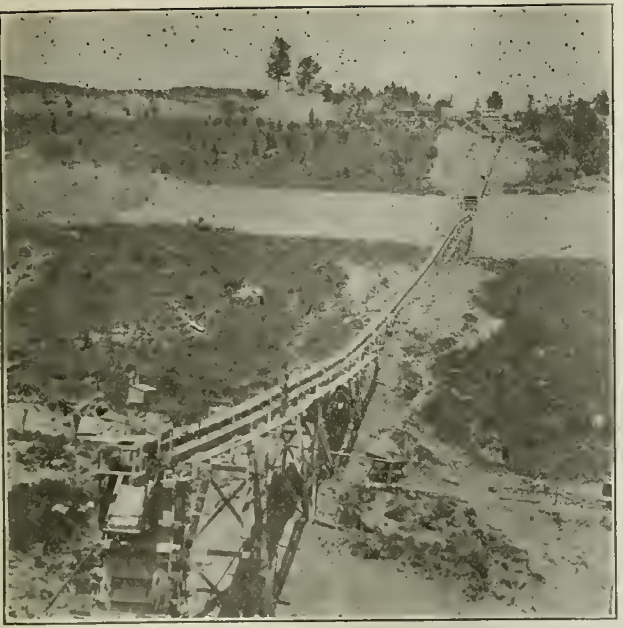
The most imposing feature of the plant for constructing the dam is the cableway, which is a Leschen cable 1,900 feet long carried by two cable towers each 124 feet high. These towers were designed and the machinery for operating the cableway was furnished by the S. Flory Manufacturing Company. This cable is suspended over the line of the masonry dam and is being used for removing excavated material and will later be used for bringing the construction materials to the dam. The cableway has a capacity of 10 tons with a speed of 1,000 feet per minute. It is operated by a 300 h. p. G. E. motor with magnetic control and special solenoid brake.

In addition to the cable, the contractor has installed near the lowest part of the excavation four steel derricks with 110-foot masts and 100-foot booms, each of 10 tons capacity and operated by a Lambert electric hoist. Also there are several smaller derricks for local handling of material.

For placing the concrete in the deeper part of the dam, the contractor has installed a concrete tower 220 feet high, placed on the bank of the creek alongside the concrete mixer, and in the bed of the creek an auxiliary tower 250 feet high. The towers, chutes, hoppers, mixer and other features of the concrete plant are all of Lakewood make. The material excavated that is to be wasted is removed to a point below the dam. Rock which is suitable for concrete is removed in skips by the cable and carried to the crusher plant, where it is



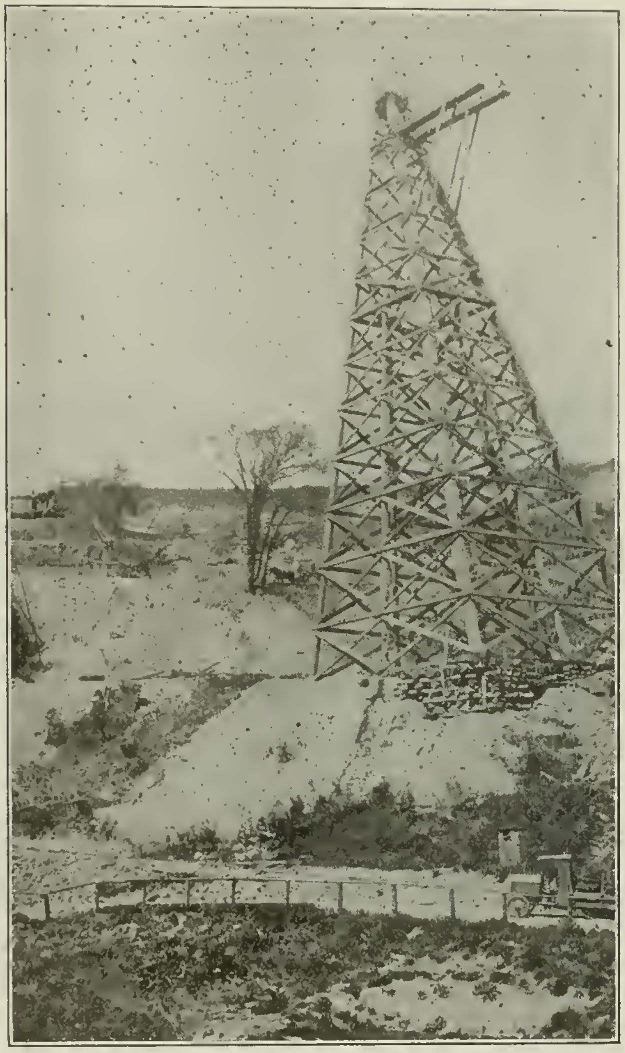
MODEL OF GILBOA DAM, SCALE ONE IN TWENTY
Head equivalent to 8 feet,—79,000 cu. ft. per sec., or 251 cu. ft. per sec. per sq. mi. Note vanes on crest to divide flow.



BELT CONVEYOR BRINGING EARTH FOR EMBANKMENT FROM HILL SIDE MORE THAN SIX HUNDRED FEET AWAY

broken up and carried to elevated bins by a belt conveyor. From these bins it will be discharged directly into the mixer by gravity and from the mixer to the bucket of the concrete tower or other conveyance.

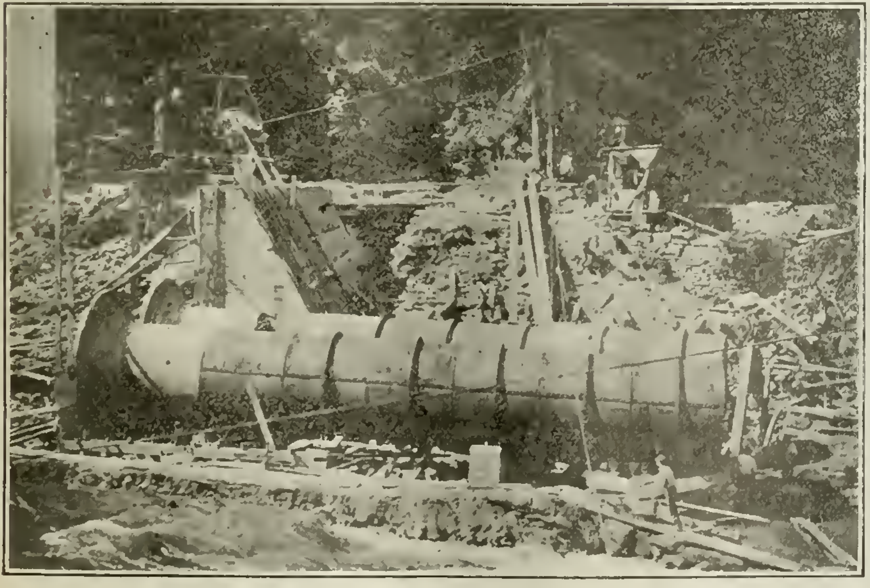
For operating the drills and other machinery the contractor is using compressed air, the plant consisting of two Ingersoll-Rand compressors each with a capacity of 1,060 cubic feet of air per minute at 100 pounds pressure, two are 206 h. p., 44 ampere, 2,200 volt synchronous motors, two 125 volt direct current generators and two transformers and two switchboards. All the electrical equipment was furnished by the General Electric Company.



TOWER 124 FEET HIGH FOR CARRYING 1900-FOOT CABLE

Size of tower may be realized by noting truck in right foreground and wagon between tower and tree.

The dike embankment is being made with clay obtained from near the top of the hill to the west and is brought to the embankment by a belt conveyor more than 600 feet long. Where this conveyor intersects a road it is carried under it in a tunnel or culvert. The excavation is about 250 feet higher than the embankment, so that the operation of the conveyor is assisted by gravity. With this long conveyor there is considerable stretching of the belt and during the first few weeks of operation several feet of slack had to be taken up in the cable every few days, while a weighted idler suspended on the return portion of the belt takes up the slack that cannot be eliminated otherwise. The dirt so brought to the dike is being spread in 4-inch layers and rolled solidly with an Austin roller.

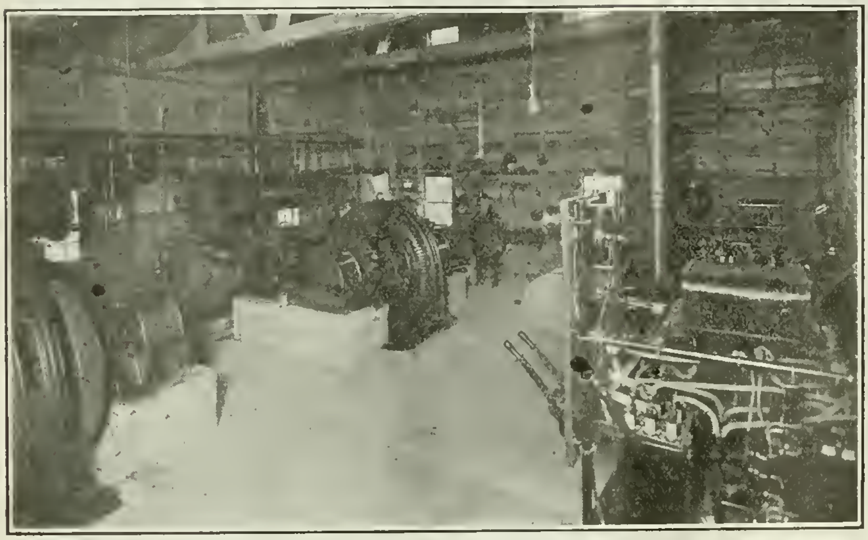


UP-STREAM END OF STEEL PIPES IN COFFERDAM

Note carefully constructed forms for bell-mouth entrances in upper face of coffer-dam.

A part of the rock for the concrete will be obtained from the excavation for the dam, but the stone for the ashler facing and for the balance of the concrete will be obtained from a quarry in the side of a hill about 500 vertical feet from the dam and about 1½ miles distant. The nearest available sand is to be obtained from a point about 2½ miles up the valley and will be brought to the work by a narrow gage railway.

Originally two roads followed up the valley parallel with the Schoharie. These roads will be entirely covered by the reservoir and the Board of Water Supply has provided instead two new roads, one on each side of the valley and a little above the flow line of the reservoir. These roads were included in a separate contract and were among the first items of the work to be constructed. All highway work in the immediate vicinity of the dam was included in the dam contract and it was necessary to complete this work first so that public travel could be diverted away from the site of the construction operations and onto the new routes laid down and approved by the courts.



INTERIOR OF AIR COMPRESSOR PLANT
Contains two compressors, each with capacity of 1,060 cu. ft. of air per min. at 100 lbs.; two 206 h. p. synchronous motors; two 125-volt generators; two switchboards.

American Water Works Convention

On Thursday afternoon the discussions of the superintendents' day topics were renewed, reviewing again those discussed in the morning. First, however, a paper was read by W. Montgomery Mitchell entitled "Mechanical Aids in Distribution Work," describing experiences and appliances used in Detroit.

In 1920 the Detroit water works laid 135 miles of main. The year previous only 49 miles had been laid, 111.5 miles in 1918, 70 miles in 1917 and 492 miles in 1916. Since 1918 little of such work has been done by contract, but most of it directly by the department. The soil in which the mains are laid is sand and clay and is ideal for machine trenching. The city owns three yards in which to keep its machinery and is contemplating a fourth. During the present season, the officials are disappointed if the reports for any day indicate less than one mile of pipe laid. Backfillers as well as excavators are used, but those that have been in service show a high percentage of repairs and should be of heavier construction. In excavating in streets where gas services have already been laid, these services are located ahead of the excavation, are dug down to and sections cut out of the service somewhat longer than the width of the trench, and a new section inserted in the service by means of couplings. When the excavator reaches a service, this short piece is taken out for a few minutes until the excavator has passed and is then returned permanently in place. There was considerable discussion of this paper, which was followed by moving pictures of trenching shown by the manufacturers of Austin trench machinery.

V. Bernard Siems, principal assistant engineer of the water department of Baltimore, then read a paper describing the operation of trench excavators and other mechanical equipment used by that department. Mr. Siems gave a number of tables and diagrams furnishing data concerning the operation of this equipment, which we expect to publish in a later issue of Public Works. Mr. Siems' paper was followed by moving pictures showing Parsons trench machines in operation. William Luscombe, of Gary, Ind., stated that trench machines had been used successfully in sandy soil. With reference to excavation in such soil, Mr. Lieson said that in such soil which would not stand without sheeting, it was generally possible to prevent caving by spading down the banks to a slope of one-half to one or flatter, the material so spaded down being removed by the excavator, and that this removing of additional material was generally much cheaper than sheeting or than hand shoveling.

SUPERINTENDENTS' DAY TOPICS

Discussing, among the "topics," the question as to causes of failure of cast-iron pipe, Mr. Lieson told of one 48-inch line in Louisville in which there had been 47 breaks in 20 years. A study of the records showed that 38 of these had occurred in cold weather, 25 of them being in late fall. Apparently they were not broken by the pressure, which was only 45 pounds. Twenty-five of the breaks were so exactly circumferential that 21 of them were repaired by use merely of a split sleeve. This was the first 48-inch pipe that had been made by the foundry from which it was obtained and it seemed probable that, being new to the casting of such large sizes, it had probably removed the pipes from the moulds too rapidly, which caused internal stresses. It was stated that the centrifugally moulded pipe (a process which was described in PUBLIC WORKS several months ago) can now be bought in Toronto at 25 cents less per foot than Class B pipe. Arrangements have been made for laying four miles of it in a town near Toronto. As yet no arrangements have been made, to the speaker's knowledge, for manufacturing this pipe in the United States.

None of the members gave any experiences with the use of substitutes for lead for joints or with foundry-made joints. F. C. Amsbary stated that he had used considerable "Universal" pipe and so far it had been a perfect success.

As to the laying of water mains in streets, in parking and in alleys, it was stated that the parking was used in Champaign-Urbana with general satisfaction. The pavement was not dug up for carrying the services across the street, but the services were pushed across underground. Several members stated their opinion that water mains should never be laid in alleys.

The question receiving more discussion than any other was that entitled "How to Gain the Good Will of the Water Consumer and Still Enforce Proper and Reasonable Regulations and Keep the Water Consumption Within Reasonable Bounds." E. E. Davis, of Richmond, said that this was impossible. Howard B. Claflen, of Phoenix, had found difficulty in satisfying consumers when they are required to pay for the laying of mains. In Toronto the owner pays for the main and owns it in the same way that he does the sidewalk or street paving for which he is assessed. He pays, however, only the amount which it would cost to lay a 6-inch main, and if larger size is necessary in a particular street, the additional cost is taken from the general fund.

Dow R. Gwinn advocated advertising in the daily papers, both to obtain the good will of the paper and for the publicity, and in these advertisements taking the public into the confidence of the company or department, telling them the exact facts concerning the plant and its operation. He also insisted on courtesy to consumers at the counter and elsewhere. One of the favors done the consumer by his company was to examine a service without charge or even request when a high meter rate appeared to show a leak in the plumbing. His company kept the grounds at the pumping station in a park-like condition and a part of them were laid out in tennis courts which were free to the public conditioned only on being engaged beforehand, usually by telephone. School children were considered good publicity agents and were always welcome at the plant and shown about it by the employees. One member stated that in his city a woman was used as complaint clerk, since the average man would considerably reduce the heat of his complaint when encountered by a smiling woman. Asked what was done when the irate consumer was a woman herself, he replied that they had a good-looking man clerk as an understudy for the woman. He had made a practice of sending with each bill a slip giving information about the plant, different matter being sent out each month. The chemist and bacteriologist of the plant delivers lectures at intervals before the high school pupils on water and the purifying of it. He also believed it was advantageous to cultivate the various civic societies in the city. They had each month a visiting day at the plant in which a light lunch was served free to all visitors. Another superintendent found it advantageous to help out consumers in simple plumbing troubles, such as leaky faucets or other minor matters. The superintendent of Centerville stated that his company wished to be accommodating but recently was compelled to deny a request that they stock their reservoir with fish and allow the citizens to fish in it.

F. D. Manville, of Newport News, stated that his department offered prizes to school children for essays on water chemistry and it was stated that in Richmond also the school children were asked to write essays describing the water works or some feature of them. In Champaign, Ill., signs were placed on all buildings of the water works: "Visitors Welcome," and classes from the public schools visited the plant frequently. One member suggested that monographs on different features of water works practice, such as metering, purification, sterilizing, etc., be written and furnished to a Chicago company, which makes a business of distributing such monographs to the public schools throughout the country. Mr. Claflen, of Phoenix, said that his city had to educate the taxpayers in order to get a bond issue through. The water inspectors visited all consumers and endeavored to enlist their aid in stopping waste. At the end of the discussion the members voted that a committee be appointed to arrange for an exchange of advertisements which they had used in their local papers, either directly or by sending them to the secretary and having him circulate the copies among the members who desire them.

Discussing the topic, "Experience in Water Works Operation Under Public Utility Regulations," E. B. Whitman advocated that new companies make rates higher at the outset than was found to be the practice in Maryland, since it is much easier to lower rates than to raise them and less likely to cause enemies to the water works. Mr. Whitman is a member of the public utility commission and stated that the commission did not find either pleasure or popularity in authorizing a plant to raise rates, although practically all of its decisions so far had been the granting of such authority. It was quite common to find that small companies did not have intelligent management and were not able to properly calculate the rates necessary to operate the plant and meet all overhead charges, and such companies were almost sure to get into financial difficulties. Charles D. Vail, of Denver, Colo., said that in his experience there was more mismanagement under municipal than under private control.

Under the topic of "Services," W. H. Harrison, of Memphis, stated that his city used double-strength lead pipe for services. In Watertown a short length of lead pipe is used between the corporation and an iron service, but in a straight line with the service and not as a goose-neck. It appeared that quite a number of the cities represented did not use a goose-neck in making service connections. Erie was said to be just now in difficulty in that it was called upon to tie up a large amount of capital by laying services prior to street paving, from which services no revenue will be secured until they are connected up for use. Concerning who should pay for maintaining the service, several members believed the department should pay for the maintenance, one stating that if the consumer were required to keep up the service it would cost the city as much in the end and the consumer would feel that he was being imposed upon.

J. G. Peltz, of Lakewood, Ohio, reported that his city had used straight iron connections to the main, but that half of them had broken from the main. It being suggested that the corporation cock be placed on top of the main instead of at the side, Mr. Proctor stated that this was apt to cause an air trap in the service. Mr. Harrison, of Memphis, having asked for a show of hands as to how many members represented cities where the services were paid in full by the water works and how many where they were paid by the consumer, it was shown that in 13 of the cities represented the water works paid for the services and in 26 the consumer paid, 23 of these being municipally owned plants. One member stated that in West Virginia the company is required by the public utility commission to furnish both service and meter, while another stated that in New York state the consumer must pay for both; and it was stated that in Montana the commission rules that the utility must pay for the corporation and the consumer for the service.

A Three-Section Bridge to Canada

A project is being serious considered for connecting Kingston, Ont., with New York state near Cape Vincent by a series of three bridges, one from Kingston to Wolfe island, another from Wolfe island, another from Wolfe island to Carleton island and the third from Carleton island to New York state. The total length of bridge involved would be between three and four miles, about 1½ of these being between Kingston and Wolfe island. It is stated that the Quebec bridge will never carry in a year as much traffic as would pass over this bridge in a single summer month.

Long Concrete Bridge Planned

Rochester is to build a concrete bridge with a 450-foot span across the river, which span is believed to be longer than that of any existing bridge of this type. A similar bridge now under construction at Minneapolis will have a span of 400 feet.

Concrete Bridge Construction

Steel truss arch centers. Fitting, striking, adjusting and shifting centers. Ordinary and special supports for centers. Cantilever arch construction. Self-supporting arches. Concreting operations.

STEEL ARCH CENTERS

Where there are a number of duplicate arch spans to be erected or where the span is very long, it is generally preferable, and sometimes unavoidable. to support the arch during construction on steel truss centers which are generally substantial arch spans themselves, designed especially for the purpose and often equivalent in strength and workmanship to permanent bridge trusses. Of late years, since timber has been so scarce and costly, the proportionate advantage of steel arch centers has increased until now it is claimed that they are more economical than timber for spans of as little as 30 feet, when they can be used several times. Such centers can, of course, be designed and built in any structural shop. Their design and fabrication has been specialized and they are manufactured in quantities and sold or rented to contractors. and are thus available at short notice and in almost any size or weight.

For ordinary purposes each span requires two or more sets of two trusses each, braced together to make stable units parallel with each other, the number of units depending on the width of the concrete structure. They are made with a variety of detail. but are almost always shop riveted as semi-trusses with Fink type or triangular bracing and horizontal bottom chords connecting the lower extremities or points a little above them, as may be convenient. The bottom chord is supported by vertical suspenders and is usually adjustable, and adjustment is also provided in the special panel where the semi-arch trusses are connected at the crown.

The trusses are usually shipped from the shop in sections as large as can conveniently be handled by railroad cars and are assembled in horizontal position at the site and erected by derricks or cableways or other convenient apparatus that handles them complete for short spans and generally as semi-trusses for long spans. The pair of trusses being connected together by horizontal and diagonal members are self-supporting and thereafter are shifted from place to place as a single unit.

FITTING, STRIKING AND SHIFTING STEEL CENTERS

It often happens that, in a given bridge, there are several spans varying only by slight differences in length, and in such cases the centering trusses are generally built long nough for the longest span with detachable end panels that can be removed to make the center panels fit the shorter spans. If the curve of the intrados varies in the different spans suitable filler pieces are provided on the top chords of the centering trusees to finish them up to the required curve for the lagging, which generally consists of transverse horizontal planks.

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*Part I—Substructure; concrete mixing and distribution; concreting in successive longitudinal halves; precast slab and girder spans, and arch barrels and ribs was published June 25.

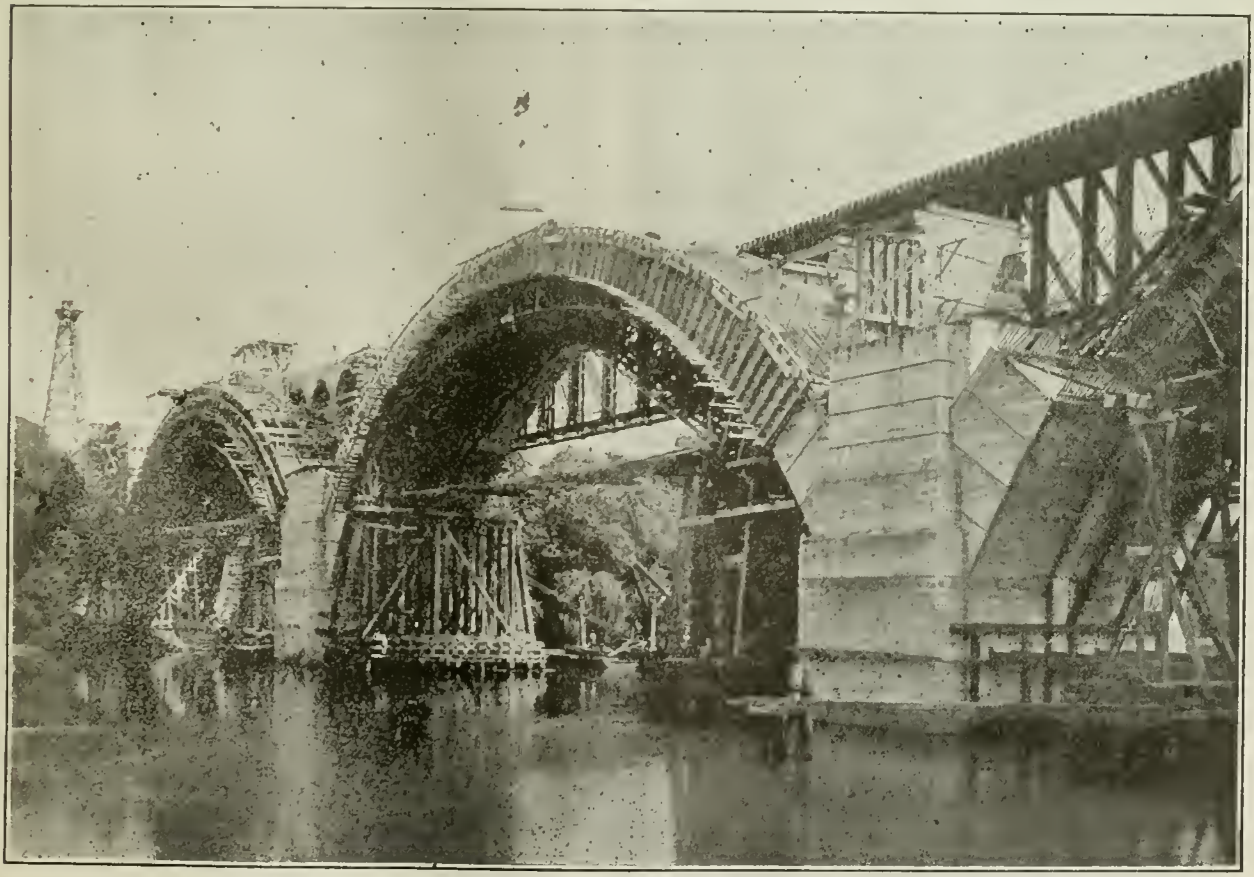
The ends of the centering trusses are generally supported on horizontal girders transverse to the bridge axis and these in turn are supported on adjustment wedges, jack screws, shims, pedestals or a combination of them, that allow them to be lowered a few inches, an operation which includes the adjustment of the bottom chord and perhaps of the crown panel, to strip the trusses from the concrete and give plenty of clearance for their removal. For a short bridge usually only enough trusses for one span are provided and for a long bridge enough for two or three spans are provided and are shifted from span to span.

As fast as one span of a multiple arch bridge is completed the arch centers are struck and moved transversely, generally on rollers, until they are free of the bridge and then moved longitudinally on rollers or cars or scows, or handled by derricks or travelers to another span, where they are moved back again transversely, adjusted to the proper elevation to receive the concrete, and so on. In replacing an existing bridge, the concrete arches are often built in longitudinal halves complete from one end of the bridge to the other, after which the arch centers are transferred to the opposite side of the bridge and the second half is built in the same manner as the first half was built.

SPECIAL METHODS OF SUPPORTING WET CONCRETE

Several ingenious devices have been planned for the utilization of the reinforcement in steel arches or in girders to develop their strength in advance and permit them to be self-supporting and also to carry the weight of the forms and the wet concrete during the construction of the bridge. In some cases the forms for concrete arch spans have been suspended from existing structures or from falsework trusses built over them when it was impossible to provide clearance to support them by structures underneath. Designs have also been made for the erection of light falsework on which a lower portion of the permanent arch could be supported while curing. Soon this portion of the arch develops sufficient strength to support the remainder of the arch, which is then concreted on it, completing the barrel or ribs, thus permitting the falsework to be made much lighter and be removed much more quickly and easily than if it had to support the entire weight of the final arch.

A considerable degree of convenience and economy was attained in a very novel method of can-

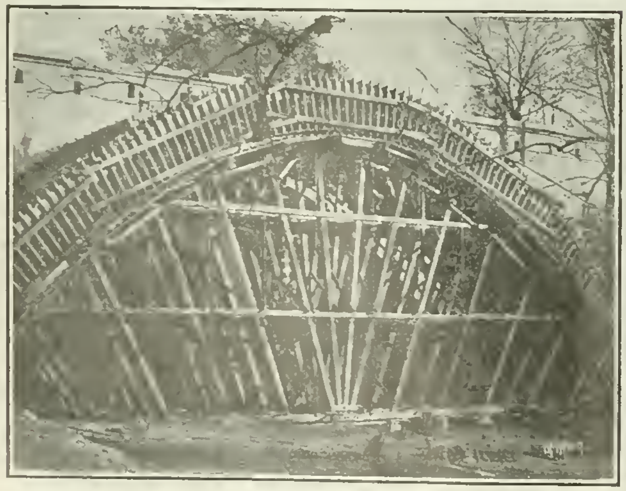


REPLACING PENNSYLVANIA RAILROAD BRIDGE WITH DOUBLE TRACK CONCRETE ARCH SPANS CONSTRUCTED IN SUCCESSIVE LONGITUDINAL HALVES SUPPORTED ON STEEL TRUSS CENTERS tilever arch construction successfully adopted by J. H. Furtes for the construction of the Harrisburg viaduct, where he designed the arches with special reference to their erection in successive segments from the skewback to the crown, the segments being properly reinforced and bonded together and having the reinforcement very carefully proportioned to the compressive strength and provided with the proper anchorage which enabled each section to support the next section built on as the work advanced by the cantilever method of erection, until it was completed without falsework supports, thus avoiding costly construction involving high trestle bents and the obstruction of the spaces between the piers.

CONCRETING OPERATIONS

For short span arches the concreting is usually done in a single continuous operation carried on, day and night if necessary, until all of the concrete is placed for an absolutely monolithic structure from skewback to skewback. If hinges are required they are provided by heavy plates, castings or pin joints built in at the crown and skewbacks. For long spans the arch is usually made in sections like voussoirs separated by construction joints in radial planes. These voussoirs are simultaneously concreted in pairs symmetrically arranged with regard to the center line, great care being taken to secure balanced loading on the falsework so as to prevent its irregular distortion. The arch ring is generally divided into voussoir sections from 5 to 20 feet long, and the side forms are built continuous from end to end of the span with movable transverse partitions or bulkheads completing the forms at these points of division.

Sometimes the voussoirs are all of substantially the same length, sometimes they are made alternately long and short, the latter serving as keys between the long lengths and concreted either simultaneously with them or subsequently as desirable. The final concreting always taking place at the short sections or keys usually near the crown or haunches. Each one of the set must, of course, be completely concreted at a single continuous operation. When the arch ring or rib is reinforced by fabricated trusses, as in the Melan type, the trusses, usually spliced to pier reinforcement, are completely assembled in the forms and the concreting, commencing at both skewbacks simultaneously, is continuous until it is completed at the crown.



FAN-SHAPE CENTERING SUPPORTED ON MUD SILLS AT SKEWBACK LEAD

In long span bridges the footings for spandril columns, walls or arches are usually commenced integral with the arch concrete, carried up a short distance above the extrados, and finished with a horizontal surface through which vertical reinforcement bars project to receive and bond with the concrete upper members, which are placed at a separate operation after the completion of the arch and its centers have been struck and removed. The spandril members are concreted in ordinary forms like those used for similar structures on land and may be built simultaneously with or previously to the construction of the floor slab.

The floor slab is usually of reinforced concrete made continuous except for necessary expansion joints and supported on the spandril members and sometimes on connecting reinforced concrete beams or occasionally on steel I-beams enclosed in concrete.

Usually the outer edges of the floor platform are especially designed to receive the parapet or handrail which is concreted in a separate operation and may either be a solid mass built in situ, in forms that provide for the proper mouldings, or it may consist of a base built integral with or separate from the floor slab and having provisions made for uniting it with vertical ballusters, panels and hand rails of pre-cast concrete that are usually constructed in special forms and with a specially fine mixture of concrete. Great care should be taken in the design and specifications to very clearly show the distinction between the handrail and the floor system so as to avoid any confusion of unit prices for different classes of work.

Provision should be made for the cleaning and rubbing of all exposed concrete surfaces as soon as the forms are stripped so as to give it a uniform appearance. The surface may be attractively diversified by washing some parts of it and using wire brushes while the concrete is soft to give it a pebbled effect, and by bush hammering panels of it, or by dressing the hardened surface with a sand blast.

Investigation of New Jersey Water Supplies

On July 1 an appropriation of $33,300 provided by the recent session of the New Jersey legislature became available to permit the State Board of Conservation and Development to begin a complete investigation of the unappropriated watersheds of New Jersey available to serve the future needs of the metropolitan district. It is proposed to extend this survey over south Jersey as well as north Jersey. The ultimate aim is to obtain an accurate and comprehensive knowledge of the water resources of the state to be used in the future in apportioning these resources among the various communities in proportion to their needs, so far as this can be made possible.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 248 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba..$3.00 year
All other countries ....$4.00 year
Charge of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

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Co-Operation of Producers and consumers of Public Works Materials

In his annual address before the American Society for Testing Materials, President George S. Webster reviewed the history of the society from its organization as a section of the international association in 1898 and its incorporation as an independent body in 1902, the latter being found necessary in order to carry out the formulation of standard specifications.

President Webster called attention to one notable characteristic of this society, in that it "forms a unique and invaluable clearing house for the exchange of views of the producer and of the consumer, from which interchange of views the best ideas are crystallized and are reflected in the standards of the society." Other societies have done this to a certain extent; for instance, the American Water Works Association gives the associate members—those having commercial interest in water works products—a considerable part in the work of the society and place on many of its committees. To a somewhat less extent the American Society for Municipal Improvements recognizes the interests of the producers in developing its specifications for paving materials and methods.

There is, however, a danger that the commercial interests of the association members may be permitted to exert an undue influence as compared to the interests of the consumer as represented by the engineer or other technical man. As Mr. Webster said further on in his address: "While the importance of the producer and the consumer meeting on a common ground in the development of standard methods of tests and particularly of standard specifications for materials, cannot be overestimated, nevertheless, it may be well to sound a warning against abuses that may arise in the adoption of standards through the possible dominance of the producer in their formation. A general belief that this was so would lessen the confidence now felt in these standards." He explains that because their expenses are paid by the firms they represent, the agents of the producers are likely to attend committee meetings in greater number than are the representatives of consumers who generally have to pay their own expenses; added to which is the fact that the commercial interests of the former tend to make them more active than do the professional interests of the latter.

It does not need any argument to convince the average public works official that it is not desirable to allow the producers to dictate the characteristics of the materials which he must use in the construction and iperation of public works. It has recently, however, been recognized that there are also objections to determining the various characteristics of the materials to be used from theoretical considerations only and without consideration of the producers' standpoint. By taking account of the latter it may frequently be possible to secure equally as good results at a less cost, the producer being able to suggest equally satisfactory alternatives which can be secured through less costly manufacturing details.

The plan that has been followed for a number of years by the American Society for Municipal Improvement seems to us an excellent one; this being to have both producer and consumer represented on the sub-committees that evolve the specifications for various materials, the views of both being then submitted to a general committee composed entirely of engineers selected for their wide experience and judicial minds, who often effect a combination of the ideas of the representatives of both producer and consumer which will secure the best results at a minimum cost. A somewhat similar scheme is that put into effect this year in the American Water Works Association, the "Council on Standardization" being the general committee which reviews the work of the sub-committees on the various subjects coming within the scope of the council.

The getting together of the consumer and the producer will undoubtedly be productive of much improvement of construction materials and methods within the next few years, providing the producers do not secure the dominance that Mr. Webster warns against; and we believe that the common sense of American engineers can be relied upon to preserve proper balance.

Stupendous Construction Requirements

According to official data just issued by the Federal Reserve District of the United States Treasury Department the estimate of construction requirements that are now current are too great to be easily comprehended. They are doubtless larger and more varied than have ever existed before in any nation and with the abundance of wealth, unemployed capital, the great quantity of labor already available and that seeks admission to our shores, and the mechanical equipment and power facilities that are or soon may be in readiness, there seems to be no reason other than the lack of confidence by capital and of willingness by labor and all around honest energy and determination to make not only the coming year but many succeeding years unparalleled epochs of prosperity and development.

These requirements are or should be all of them under public and private control and with a proper sentiment for efficiency, hard work and reasonable profits, will ensure the application of the abundant laws that are already quite adequate for construction business, and with it commercial and financial interests throughout this country will advance and grow as never before.

The Treasury statement places the necessary sum for the construction of factories, schools and the like at $6,000,000,000; rehabilitations of railroads, one-third of which should be undertaken almost immediately, at $6,000,000,000; public utilities for community development, especially in outlying city sections, at $2,000,000,000; and highway construction at $1,500,000,000, making a total of $14,500,000,000, which may be considered as deferred domestic construction exclusive of the vast amount of other work, including foreign business that is urgently needed.

The Printers' Strike and "Canadian Engineer"

Our contemporary, the "Canadian Engineer," ordinarily published in the same size and general arrangement as Public Works, appears this week printed in the size and form used by the daily papers. Because of the printers' strike, "Canadian Engineer," along with other papers, found itself unable to get out its publication and the issues of June 2 and June 9 were omitted. Arrangements were then made for printing the issue of June 16, which is the one just received, on a newspaper press, and it is expected that the next few issues also will be printed in this way.

This issue is published on twelve pages of daily newspaper size. It certainly seems curious to read on a large page two-column and three-column headings like the following: "Intermittent Aeration in Active Sludge Process"; "Canadian Water Works Meeting"; "Construction News Shows Some Increase in Construction Pending"; "Standards for Bridge Construction on Good Roads," etc., while the illustrations, instead of being photographs of the latest politician or divorcee to reach prominence in the public eye, consist of diagrams illustrating the operation of activated sludge beds. The advertisements also are confined to firms dealing in boilers, turbines, pipe, asphalt and other road materials, liquid chlorine, water meters, pumps, filters, concrete mixers, etc.

We would not be in favor of the general practice of publishing technical papers in this large size or in the form which, because of a habit acquired by reading the daily papers, tempts us to throw it way after a casual reading of the headings; but we offer our congratulations to the "Canadian Engineer" for so successfully solving the same strike problem that confronted ourselves and other American periodicals last year and hope that their enterprise will aid them in securing a settlement of their difficulties satisfactory to themselves.

Relation of Filth to Public Health

One of the earliest of the modern profession of health officer and one with the highest standing in that profession is Dr. Charles V. Chapin, superintendent of health of Providence, R. I., who is now 65 years old. Dr. Chapin has seen and played considerable part in the development of municipal sanitation, and has retained his ability to recognize the truth of new ideas and defects and incompleteness of old ones when these have been demonstrated. His opinions are therefore worthy of the greatest weight. Certain of these, which were conveyed in a lecture delivered last November at the School of Hygiene and Public Health at Johns Hopkins University, are of special interest to sanitary engineers and municipal authorities. All such would do well to read this lecture in its entirely, but for the benefit of those who cannot do so we are quoting below excerpts from the lecture, endeavoring to combine these in such a way as to present fairly the author's ideas, although of course these brief selections do not give them with completeness.

"During its first thirty or forty years (of a health movement originating about 100 years ago), modern preventive medicine was almost completely dominated by the filth theory of disease. The central idea was that decomposition and fermentation give rise to poisonous gases or, as some thought, to living germs, which are carried by the air and, falling on human beings, cause in them the epidemic diseases. It was also thought that, besides causing specific diseases like cholera, typhus fever and diphtheria, these emanations from filth could undermine the general health and pave the way for infections that might otherwise be resisted or lead to all sorts of debilitated conditions. . . .

"The principal aims of the early promoters of public health were clean streets and yards, clean houses, removal of all 'nuisances,' the prevention of crowding, both of houses on the land and of people in the houses, better house construction, the building of sewers, the construction of water closets or yard privies, and the supply of unpolluted water. It is worth noting that special emphasis was not laid on pure water at first, for it was hard to convince such firm believers in airborne infection that water-borne infection is far more important.

"Now, all these aims are most desirable. Comfort and decency, as well as health, demand them. That we have cleaner streets and areas than our ancestors, that we have good plumbing, that our houses are better and that most of our cities have a plentiful supply of good water, which after use is carried away by the sewers, is due in no small measure to the efforts of the early English sanitarians. That these things would have come in time is probable; but that progress would have been slower is also probable, as is indicated by the comparatively backward state of sanitation in France, which did not feel the direct influence of the English reformers. . . .

"We can now be sure that the proper disposal of human excreta in sewers or privies and the introduction of a pure water supply have been the chief cause of the banishment of cholera and typhoid fever and the diminution of diarrhea. That less overcrowding has been of some help in keeping people free from vermin and hence from typhus fever is probable. It is probable, too, that better housing and plenty of water have helped to make people neater and hence have been of some service in preventing those diseases that are spread by the transfer of the secretions of the nose and mouth; but success in the control of these diseases has not been so startling as to make such a claim of importance. . . .

"How exclusively the filth theory dominated preventive medicine is well illustrated by the textbooks of the time, which devoted scarcely one-tenth of their space to the direct control of contagion, and the remainder to man's environment. In Boston, the sole duty of the 'superintendent of health' was street cleaning and scavenging. The first report of my predecessor, the first superintendent of health of Providence, who was elected in 1856, dealt almost wholly with nuisances. The first report of the Metropolitan Board of Health in New York, organized in 1866 because of cholera, besides an account of the cases and hospitalization of that disease and quarantine, is almost entirely devoted to nuisances, decayed food, offensive trades and the like. About the only employees of boards of health in those days were nuisance inspectors. As late as 1898, after the American occupation of Havana, our government officials, even health officials, were so imbued with the idea that municipal house cleaning is synonomous with preventive medicine that an engineer, Colonel Waring, was sent to Havana to clean the city and thereby exterminate yellow fever, which had been endemic there for over a century. He did his work so well that all were agreed that Havana had been made the cleanest city in the western world. You all know the sequel. The next year there was an unusually severe outbreak of this disease, which was especially prevalent in the better portions of the city. . . .

"Although there were some important truths in the generalizations of the early promoters of public health, and although their projects for civic betterment saved many lives and did much for human comfort and convenience, there were several errors which have had an unfortunate influence on preventive medicine and still have today.

"One of these is that disease breeds in filth instead of being merely carried in filth.

"Another is that all kinds of dirt are dangerous, not merely the secretions and excretions of the human body.

"A third unfortunate hypothesis is that infectious diseases are usually air-borne.

"We now know that infectious disease does not breed in filth, or, with the rarest exception, in anything else except the bodies of men and animals. The infectious diseases are transmissible diseases. They spread from person to person. They do not arise afresh in decaying matter. . . .

"We now know that although some kinds of dirt are dangerous, extremely dangerous, most kinds are not. It is the dirt that carries the secretions and excretions of the body which is dangerous. . . .

"There are a vast number of minor nuisances connected with care of cellars, yards, lots, garbage disposal, dumps and defective drainage which it is still the fashion to expect the health department to look after, though they usually have scarcely the remotest relation to health. All this should be turned over to the police department which, with its large number of patrolmen, is much better equipped. . . .

"Where typhoid fever and dysentery and hookworm infestation abound, where 95 per cent of the school houses have no privy, where cities are unsewered and surface wells furnish the water supply, the health officer may well give much time to environment, and the sanitary inspector is a real promoter of health. When these communities have learned to dispose of their excreta as safely as have New York, Boston, Brookline, Montclair and Evanston, where the typhoid fever rate almost rivals that of the English cities, they, too, can turn over to the police what remains of nuisance control."

Mr. Chapin divided the modern health movement into three phases, the first of which concerned itself generally with environment, as described above, the second with the isolation of the sick, and the third and latest with personal instruction and cure. Concerning the second he says: "Unquestionably the most brilliant result of these studies was the discovery of insect transmission. It was demonstrated in 1893 for a disease of cattle by Smith and Kilborne. In the last year of the last century it was proved to be the mode of transmission of malaria, and in the last months of that year, of yellow fever. Within a short time, African sleeping sickness, bubonic plague and typhus fever, as well as several less important diseases, were shown to be spread from person to person by insect carriers. That insects spread disease is a most important discovery of preventive medicine. If it had not been for the interruption of the war, yellow fever might now, perhaps, have become extinct."

Dr. Chapin finds in the present period of personal instruction the greatest possibility of improvement through enlisting the intelligent activities and precautions of individuals in their own behalf. He warns, however, against the tendency to give false or exaggerated ideas, sometimes with the belief that only by exaggeration of dangers can the people be aroused to appreciation of them. "A few years ago someone started writing ridiculous verses about the fly which seemed to please the people's fancy and there has been a constant output of this 'poetry.' It usually inculcates the most erroneous ideas about physiology, germs and the cause of disease, as well as greatly over-emphasizing a source of sickness which is really comparatively unimportant, at least in the northern part of our country. . . . Health bulletins are still harping on the idea that all dirt is dangerous and that disease germs breed in dirt and fly through the air. . . . The greatest danger of the educational movement in public health is that it will be wrecked on the shoals of error."

Mechanical Side of Highway Construction*

Standardizing of equipment urged to save costly overhead.

All the average road builder wants is a light, portable plant capable of handling, mixing and finishing four hundred cubic yards of concrete every day, with no delay for repairs. This, at least, is the ideal of which he dreams and it might serve as a measure in devising improvements in the methods employed. Present methods are still capable of improvement and they ought to receive the joint study of contractors and engineers. The charge has been made that modern road building methods have so increased overhead expense that they have accomplished little saving. This may be an exaggeration, but the elaborate equipment now used has undoubtedly increased the overhead to such a degree that steady output of the plant is essential to financial success.

PRINCIPAL CAUSES OF LOSS

Heavy losses were sustained by contractors doing road construction last year, principally on account of interruptions to their work. Their gangs were either disorganized or held on the payroll to avoid disorganization, and either plan was costly. Hence, whenever the machinery stops the unit overhead expense leaps upward.

In order that this overhead expense may be kept within reason and that highway costs may be estimated with profitable accuracy, it is essential that contractors have equipment capable of maintaining a steady flow of materials; first, from unloading point to mixer and, second, from there to the finished road.

. . . The slogan of the designer should be "Make the machine foolproof." Increased strength may demand heavier parts and increased first cost, but this is inconsiderable compared with the loss due to one breakdown. . . . The majority of delays are traceable to three main causes: first, lack of skilful mechanics; second, lack of standardization in design and, third, lack of accurate information concerning the adaptability, capacity and operation of machines. . . . An economical solution of the shortage of good operators might be effected by establishing a short course of instruction for mechanics. During winter months when construction is slack, these men could be instructed at the manufacturers' shops, or possibly at some of the engineering schools. In either case, they could be instructed to operate and exercise care in maintaining equipment. Savings effected in the field by competent operators would amount to many times the cost of their construction. . . . Road building plants are generally made up of machines from half a dozen different manufacturers and to be prepared even for the usual run of minor field repairs on all machines requires a more or less elaborate machine shop. The financial burden of carrying duplicate units or a sufficient number of spare parts is too great for an already heavy overhead, and in order that this expense may be held within reason, greater interchangeability of parts should be possible. . . . By reducing the number of different sized bolts and threads to a minimum, many more repairs could be made at the site of operation without even necessitating a trip to the job machine shop.

COST OF DELAYS

To build a medium sized high-type section of highway requires a daily field payroll of three or four hundred dollars and an overhead of probably another hundred. So that five hundred dollars per day is not an unusual cost. An employee cannot be laid off every time a breakdown occurs, and since the overhead goes steadily on, fifty dollars an hour may be considered an estimate of the cost of equipment delays. . . .

INFORMATION NEEDED

The third pressing need of road builders, and the one which probably results more frequently in disaster, is a lack of unbiased and authoritative information concerning the adaptability, capacity and operation of machines. . . .

What contractors need is accurate data showing under what conditions a certain type of machine is suitable, how long it may reasonably be expected to last and what output it can deliver under normal working conditions. If this information can be made available, construction companies may be relied upon to intelligently select machines. They will then be able to coordinate their plant and estimate their costs.

A questionnaire sent to a hundred manufacturers in 1920 showed that they possess practically none of this needed information. A few of them were able to state figures for depreciation, but the figures would unquestionably cause an unwary bidder to underestimate. One firm gave twenty years as the average life of a slip scraper. Yet an earth mover knows that constant use of a slip may wear it out in a season. . . .

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*Excerpts from paper presented at the spring meeting, Chicago, May 23 to 26, 1921, of the American Society of Mechanical Engineers by General R. C. Marshall, Jr., General Manager of the Associated General Contractors of America.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Drive Wooden Piles

By hand, by horses, with hoisting engine, with steam or air hammers, by loading, jacking, jetting, screwing, by explosives or by combined methods. Loading, testing, cutting and pulling.

Wooden piles are used for the foundations of buildings, bridge piers and abutments, retaining walls, sewers, and various other structures, especially in soft or wet ground, for substructures of piers, for river and harbor work, and for bridges and viaducts. They are also used for temporary and semi-temporary work, such as the support of derricks and heavy construction plant, and for false-work for bridges and viaducts.

When driven in large numbers the work is generally done with special or standard equipment and by trained workmen, thus securing greater rapidity, efficiency and economy than can be expected when only a small quantity are driven by the most available method and the one that involves the lowest total cost, although the cost per pile may be much greater than that of those driven by standard methods and appliances.

If the piles are very long or the conditions of driving are difficult, or their functions are very important, their selection, proportioning and driving should be under the direction of experienced engineers and contractors. In the vicinity of any large city or on the sea coast where a great quantity of piles are always being driven, and heavy floating construction plants are easily transferred from point to point, it is generally easy to secure the driving of even a limited number of piles by specialists, equipped with abundance of plant for the prompt and economical execution of the work, and if the time is not strictly limited it may be possible to secure a price for the work much lower than could be done by the ordinary general contractor.

In general construction work it is frequently necessary to drive from 10 to 100 piles at inland locations, where seaboard or metropolitan facilities are not available and the inexperienced contractor may be aided in solving his problem by the following outline of general elementary practice and conditions.

PILE REQUIREMENTS

Almost any sound, straight timber of the required dimensions may be used for piles, but the largest proportion in this country are of pine, spruce or oak. The dimensions vary from a diameter of 4 to 8 inches at the tip and 6 to 16 inches at the butts, with lengths of 10 to 60 feet, average good piles being 12 inches diameter at the butt and about 40 feet long. For extreme requirements they may be imported from the Pacific Coast up to 100 feet or even more in length, but the extra sizes are costly and difficult to secure, transport and handle. Ordinarily they are round timber with the bark on, but for special requirements they may be treated with the creosoting or some other preservative process. Their penetration may be anything short of the full length, but they are generally ordered with a slight excess so that a foot or more of the upper portion may be cut off, which is likely to be damaged in driving, and to insure the exact elevation of the top, which is generally close to the surface of the ground or the bottom pit in which they are driven, if on dry land, or near low water level if drive in the water, although for various purposes they may project several feet above the surface of the ground or the water to form a complete structure instead of merely the foundations for framed timber towers or trestles.

PILE LOADS

For piles 8 inches or more in diameter at the tips, and that are driven to a refusal of 1 inch with the last few blows of a 2,000 pound hammer, an arbitrary load of 1500 tons is often accepted. The safe bearing capacity of the piles is determined by test or experiment or is often required to conform to the values derived from the formulae

$P = \frac{2Wh}{s+1}$ for a pile driven with a drop hammer, and

$P = \frac{2Wh}{s+0.1}$ for a pile driven with a single acting steam hammer, where P is the safe load in pounds, W the weight of the hammer in pounds, h the fall of the hammer in feet, and s the penetration under the last blow, when there is no visible rebound, P is supposed to be 1-6 of the load causing failure of the pile. In any case, if their service is important, the behavior of the piles in driving should be closely noted and the loading or the number and location of the piles modified, if necessary, to correspond with the indications observed.

NUMBER, ARRANGEMENT AND PENETRATION

If possible, preliminary investigation should be such as to determine the length of the piles required, and they should be ordered to correspond with the shortest piles driven that will give satisfactory results. The character of soil, the obstructions below the surface, and the depth to rock may often be indicated by soundings with a small steel rod driven by a maul, a process by which some of the concrete pile contractors secure data for estimating in advance the depth to which their piles shall be driven.

For most purposes the pile should be driven until it will support the required working load with very little settlement, and it should be remembered that unless a pile reaches to hard bottom the bearing capacity is likely to increase considerably within a few hours after the driving has ceased, especially in very soft soil where a long pile may be driven to deep penetration with great ease, and after the driving has stopped is likely to become so firmly fixed in position that it requires heavy driving to start it again. It is almost always practicable to closely determine the bearing value of a pile by constructing a platform on it, loading it with a known weight and taking careful measurements and records of the settlement produced by the progressive and continued loading.

Excepting for clusters and for daulphins and the like, piles should not be driven closer than 2 or 3 feet apart on centers, and they should not be driven so close together that driving one pile causes the upheaval of an adjacent, previously driven pile, as is sometimes the case, especially in sandy soil.

SHOES, BANDS AND BRACES

Care should also be taken not to injure the head or the point by injudicious driving. Piles should be loaded not only in accordance with the bearing strength, determined by the formula, but also with their strength considered as long columns if they are driven in very soft materials or are very much longer than their penetration, as for instance when they are driven through deep water or project far above the surface. In the latter cases they should be X-braced as thoroughly as possible and braced with horizontal top and bottom struts in both longitudinal and transverse directions, thus reducing the unsupported lengths and greatly increasing their strength as well as their transverse stability.

Piles may be driven through almost any kind of earth, clay or sand to considerable depth and even for several feet through gravel or decomposed soft rock. In the latter case, or if they are likely to encounter obstacles, their points should be protected with a cast iron shoe or with steel straps, spiked on. In this case they are generally pointed, but otherwise the tips are ordinarily cut square. If the driving is hard, the butts should be protected by a welded steel ring like a ferrule, closely fitted to the top and removed after the pile is driven, or they may be provided with an iron or steel pile cap which receives the hammer blow and protects the wood. Otherwise the heads should be champered for 2 or 3 inches to reduce the brooming effect of the impact.

Generally when more than a very few piles are to be driven at one location it is best to provide a movable tower a few feet higher than the length of the pile and a hoisting engine to handle the piles and the driving mechanism unless the piles are driven by steam or air hammer, when they may be handled with a derrick. Or if they are driven by an hydraulic jet or some special method that may eliminate the necessity of a tower.

HAND DRIVING

For very light service, small, short piles may be driven in soft ground by hand with mauls or battering rams or in holes excavated by post hole augers in earth or clay. If only a small group of piles or a number of isolated ones are to be driven, this method may be employed or a small tripod derrick or light tower may be built and equipped with a hand windlass operating a hoisting line that passes over a pulley on the top of the tower and suspends at the free end an iron ram or hammer, weighing 100 pounds or more that is usually automatically detached when the hammer is raised to the highest elevation, allowing it to fall freely on the top of the pile that is guided in the framework of the tower. This device can be easily modified by the installation of a gasoline hoisting engine to replace the man power. In the late war the United States engineers corps developed portable pile drivers, mounted on wagon trucks, with a light tower and drop hammer apparatus that drove short small piles, chiefly for road construction. With a hand windlass the blows are slow and light and the cost of driving is excessive although there is little cost for the equipment. A modification of this system is where a team of horses is used to hoist the hammer. They are generally attached directly to the hoisting line led around a sheave or snatch block, and are driven straight away until the hammer is released and falls and they return for another trip and so on. In an instance on record, as many as 30 piles were driven in one day to a penetration of 30 feet through hard clay by a gang of six men and two teams and drivers, one team returning while the other hoisted the hammer.

(To Be Continued)

Payments For Dallas Pavements

The present plan for paying for paving in Dallas, Texas, requires the property owners to pay for the pavement in front of their holdings and the city to pay for street intersections; except that where there are street railway tracks the company pays for paving between the tracks and for two feet outside of the tracks.

Owing to the depleted condition of the street improvement fund, the city will be unable to undertake any new paving not already contracted for unless it can be relieved of the cost of the street intersections. For this reason a plan is being considered by which the property owners would have added to the cost of the street in front of their property the cost of the street intersections pro-rated according to their frontage. It is believed that this plan could be followed out only with the consent of the property owners to assume the additional cost. One objection is that raised by the contractors. They are required to collect payment for their work from the property owners, the city liens on the property being available for enforcing collection if necessary. They claim that even though property owners should consent to the increased cost, the liens could not be used for enforcing collection of such additional amount.

Recent Legal Decisions

HOLDING OVER BY COUNTY ROAD ENGINEER

The Kentucky Court of Appeals holds, in an action by a county road engineer for salary, Birney v. Ballard County, 227 S. W. 168, that the Kentucky statute of March 26, 1918, amending Act, March 23, 1914, so as to provide that the term of office of county road engineers shall begin on January 1, instead of October 1, and continue until their successors are appointed and qualified, and providing that county road engineers then in office should continue to serve until January 1, 1919, unless sooner removed, is not to be construed as meaning to definitely fix the time at which the term of office of the existing officials should expire, so as to prevent him holding over until the appointment of a successor. under the rule that where one is holding an office for a specified term and until his successor is elected and qualified, and at the expiration of the specified term no one capable of holding the office has been elected or qualified, he may hold over, and the period between the expiration of the specified term and the time when his successor shall be elected and qualified is as much a part of his term of office as was that part before the expiration of the specified term. During such period he is neither a usurper nor a mere de facto officer, but is a de jure officer, and as such may maintain an action for his salary.

WHAT CONSTITUTES A DURABLE ROAD UNDER CALIFORNIA "GOOD ROADS" ACT

The California Court of Appeals, Third District, holds, Gammon v. McKevitt, 195 Pac. 726, that the purpose of the California "Good Roads" Act is unquestionably to obtain roads of a durable or permanent character, and thereby prevent a waste of public funds by inefficient road construction. Its requirements are therefore that all main highways to be constructed and all improvements to be made by virtue of its provisions shall be of a "durable and lasting character." Permanency or durability of construction, it is held, does not mean, in the sense used in the statute, merely impregnability to any sort of an attack that may be made upon the work. These terms have, however, a well understood meaning in the public mind and in the minds of those engaged in the construction of roads adequate to meet the requirements of modern vehicle traffic. A highway subject to be inundated by flood waters during the period of its greatest need or likely to be overlaid with great depths of earth in the execution of state or federal authority, or rendered inaccessible from inevitable cause, would not be such a road as the act contemplates. Durability and lasting character must be considered in reference to availability for public travel and general road purposes. The character of the materials used in the construction of a durable roadbed would amount to nothing if it was to become overlaid with masses of earthen material to the extent that it is rendered inaccessible.

MUNICIPALITY NOT REQUIRED TO GUARD GULLY NEAR STREET UNLESS PROXIMITY DANGEROUS

In an action against a city for the death of a child who was drowned in a gully several feet deep situated 2 or 3 feet from one of the city streets, McComb City v. Hayman, 87 So. 11, the Mississippi Supreme Court holds, that the measure of a municipality's duty in the maintenance of its streets is to use ordinary care to keep them in a reasonably safe condition for persons using ordinary care and prudence; and its liability for an injury to a child caused by a defect in its streets is the same as in the case of an adult injured by such defect while in the exercise of due care. "This duty of a municipality to use ordinary care to keep its streets in a reasonably safe condition does not require it in all cases to keep the entire width of its streets open and safe for travel, provided the portion thereof set apart for travel is wide enough to be safe; from which it necessarily follows that a city is under no duty to fill up or guard a gully that may be near the street or traveled part thereof unless it is in such close proximity thereto that a traveler passing along the street and using ordinary care is in danger of falling or being thrown into the gully and being injured thereby, Butler v. Oxford, 69 Miss. 618, 13 So. 626. Tested by these rules, it is manifest that the appellant (the city) violated no duty it owed to the traveling public in not filling up or guarding the gully in which the child was drowned."

A recovery was also claimed under the attractive nuisance doctrine on the ground that the child might have been attracted to the gully by the flowers on the vines which covered its sides. To this the court gave two answers: First, in order for a thing dangerous to children to come within the attractive nuisance doctrine, it must have been artificially created; and, second, there was no evidence that the child was attracted from the street to the gully by the flowers.

FRIGHTENING HORSE BY CITY CONTRACTOR'S TRACTION ENGINE—CITY NOT LIABLE IN ABSENCE OF NOTICE

In an action against a city and its sewer contractor for injuries to a horse frightened by the blowing off of steam by the contractor's traction engine, the Iowa Supreme Court in Quenrud v. Moore-Lieg Const. Co., 181 N. W. 16, held that the city was not liable for the negligence, if any, of the contractor, no notice to the city of the alleged nuisance having been shown. It appeared that the construction company was just preparing to commence the work. The popping or blowing off steam was the first occurrence of the kind. It was not shown that the construction company had been in the habit of doing the act complained of, or that it would ever occur again. There was no element of permanent nuisance; the negligence charged was casual.

NEWS OF THE SOCIETIES

July 12-15—NATIONAL CONVENTION OF REAL ESTATE BOARDS. Chicago.

July 15—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Annual meeting. Crown Hotel, Providence, R. I.

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference. Hotel La Salle, Chicago, Ill.

Aug. 23-25—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS Annual meeting. Detroit, Mich. Secretary, Emmet P. Griffin, Superintendent of Park, East St. Louis, Ill.

Aug. 30-Sept. 1—MICHIGAN STATE GOOD ROADS ASSOCIATION. Annual meeting. Flint, Mich.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Treont Temple, Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

ENGINEERS' SOCIETY OF PENNSYLVANIA

At the annual meeting of this society on June 13 in Harrisburg it was reported that the society now has more than 600 members. New officers of the society installed at the meeting were: President, Richard V. McKay, superintendent of the blast furnaces of the Steelton plant; vice-presidents, Theodore E. Seelye, of Harrisburg, and Crosby Toppan, of Chambersburg; treasurer, Harry T. Neale, of Harrisburg; and secretary, Howard E. Moses, of Harrisburg. The board of directors comprises the above officers and also W. G. Rauch, H. E. Ehlers, W. S. Baldwin, R. B. Abbott, R. D. Gillespie, William D. Uhler, Fifford Pinchot, F. M. Masters and J. W. Sheperdson.

SOUTH CAROLINA GOOD ROADS ASSOCIATION

A number of citizens met in Columbia, S. C., on May 18, and formed the South Carolina Good Roads Association, the purpose of which, as stated in its constitution, is to conduct an educational campaign in the state in the interest of good roads and to promote legislation to secure better highways. The following officers were elected: President, Lang D. Jenning, of Sumter; first vice-president, Dr. George B. Cromer, of Newberry; and second vice-president, W. C. Miller, of Chester.

SOCIETY OF TERMINAL ENGINEERS

The Society of Terminal Engineers, at a meeting held in New York on May 10, elected the following officers: President, R. H. McLain; vice-presidents, B. F. Cresson, Jr., Maurice W. Williams, M. A. Long and Charles C. Hurlbut; treasurer, W. J. Barvey; and secretary, J. H. Leonard.

CANADIAN SECTION, AMERICAN WATER WORKS ASSOCIATION

On June 4, the Canadian section of the A. W. W. A. held its annual meeting at Niagara Falls, Ont. The morning session was devoted entirely to business, and the following officers were elected for the ensuing year: Chairman, R. C. Harris; vice-chairman, H. G. Hunter; secretary-treasurer, C. D. Brown; and trustee, James J Salmond. In the afternoon a very valuable paper was read by R. C. Snowden on the "Manufacture of Liquid Chlorine," which called forth much interesting discussion. In fact, this discussion continued so long that the other paper on "Water Supply Systems of the Niagara Peninsula," which was to have been read by F. A. Dallyn was omitted, but will be published so as to be available to members of the association. The meeting ended with a visit to the Queenston-Chippawa canal, where the members were shown about the work as guests of the Niagara water commissioners.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The Regional Meeting of the American Society of Mechanical Engineers, which was to be held in Cleveland on June 13th and 14th, has been postponed to October. The exact date, place of meeting, speakers, etc., will be announced later.

PERSONALS

Sprague, N. S., has terminated his services as city engineer of Pittsburgh, and has opened general engineering offices at 808-810 Wabash building, Pittsburg, Pa.

Hunt, J. R., has been appointed road engineer of Wyoming county, West Virginia.

Smith, E. S., formerly director of public service, Youngstown, Ohio, has been appointed chief engineer of the Ohio State Highway Commission.

Begg, W. A., town planning engineer, Department of Municipal Affairs, Saskatchewan, has been appointed director of town planning to succeed M. B. Weeks.

Verner, E. H., has been appointed acting district engineer for District No. 4, Department of Public Works, British Columbia, with headquarters at New Westminster.

Ballew, Ralph D., has been appointed city manager of Sturgis, Mich.

Davisson, William Henry, of the Interstate Commerce Commission at San Francisco, Cal., died at Oakland, Cal., on May 3, 1921.

Mylchreest, Joseph W., has been made city engineer of Middletown, Conn.

Clawson, Curtis Y., of Salt Lake City, has been appointed district engineer for Weber county, Utah, in charge of state road work.

Pihlfeldt, Thomas G., city bridge engineer of Chicago, who was dismissed last year on charges which led to a protest by the American Association of Engineers, was reinstated recently by the city civil service commission.

Kemmish, N. A., of York, Neb., has been appointed city manager of Alliance, Neb.

Stephens, U., formerly county engineer of Ballinger, Texas, has been appointed highway engineer of Road District No. 2 of Hill county, Texas, with office at Itasca, Texas.

Rhodes, Fred A., has been re-elected manager of operations, city engineer and street superintendent of San Diego, Cal.

Lyons, Lawrence, of Brook, Ind., has been appointed director of the Indiana State Highway Department.

Stinchfield, M. J., Jr., has been appointed assistant state engineer of Indiana to take charge of the drainage, stream pollution and water power problems of the state.

Chambers, John, city engineer of Louisville, Ky., has been appointed chief engineer and superintendent of the Louisville Water Co.

Campbell, Neil M., city engineer of Lake Forest, Ill., will engage in private engineering and surveying practice, in addition to his duties as city engineer.

Manley, R. G., has been appointed city engineer and superintendent of streets of Upland, Cal.

Maloney, Frank, has been appointed state highway engineer of Arkansas, to succeed V. P. Knott.

Glominski, J. A., is now highway engineer, United States Bureau of Public Roads, at St. Paul, Minn.

Higgins, Lafayette, state sanitary engineer, Iowa State Board of Health, since 1908, has resigned.

Tyler, R. G., has resigned as city engineer of Paris, Texas, to become dean of engineering at the University of Oklahoma, Stillwater, Okla.

Seavey, Clyde L., has been appointed city manager of Sacramento, Cal.

Brewer, T. M., has been appointed city engineer of Viroqua, Wis.

Kringel, August E., has been appointed city engineer of Green Bay, Wis.

Williams, Friend P., special deputy state engineer of New York, has been appointed secretary of the New York State Water Power Commission.

Reid, Joseph Y. L., has been appointed superintendent of the Trenton, N. J., filtration plant.

Morse, S. T., city engineer of Carlinville, Ill., and formerly county engineer of Macoupin county, was killed in an automobile accident on June 3.

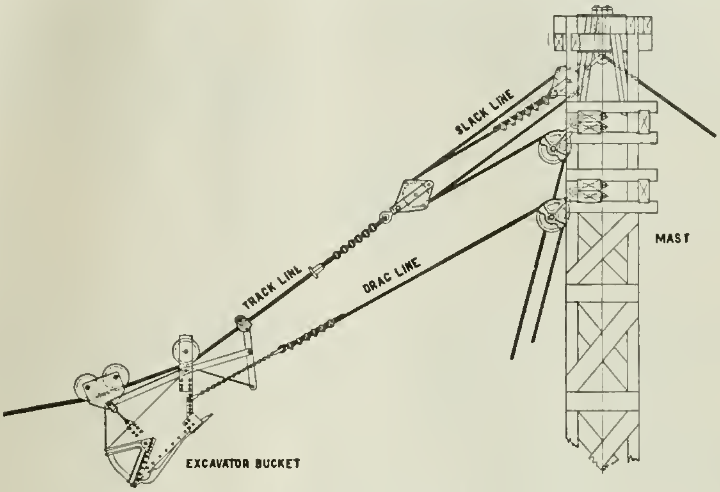
New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

SCHUTTLER DUMP WAGONS

Dump wagons manufactured by the Peter Schuttler Company are designed for road making, excavating, grading, paving and hauling building materials generally. They are made of highest grade materials and workmanship, with details developed by more than 70 years' experience in their manufacture. The 1½-yard, 2,100-pound grading dump wagon has a white oak body with full cut under gears so that the wagon may be turned in its own length. The neck is exceptionally strong and is reinforced and is lined inside and outside with steel. It is dumped by a locked foot lever that opens and closes the doors tightly. The capacity of the box may be increased to 2 yards by the use of a ½-yard extension top if desired.

Chicago 2-yard and 3-yard dump wagons have the same general features as the 1½yard wagon and the thickness of the white oak body is increased to 1½ and 1¾ inches. Like the smaller wagons, they are equipped with interlocking centerplates that keep the front gear in position at all times. They are furnished with special reducing bearings or plain axles as desired. The hinges are made of specially refined wrought iron and extend across the full width of the bottom. The front gear is equipped with patent oscilating plates to keep the body level when the front wheels pass over irregularities. The dump chains are connected by a patented equalizing device to distribute the weight of the load equally to each chain and make it possible to positively close one door in advance of the other, insuring an absolutely tight bottom.

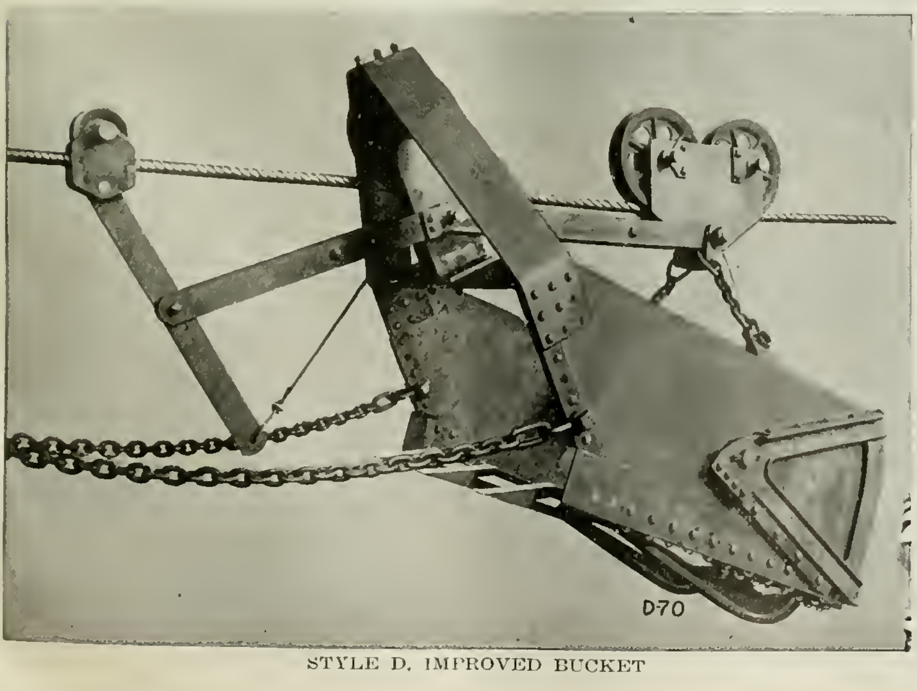


ARRANGEMENT OF DRAG LINE CABLEWAY, EXCAVATOR AND MAST HEAD

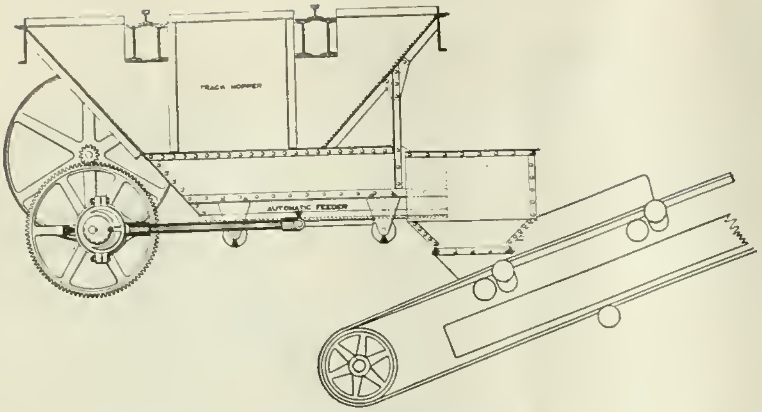
PLANTS FOR WASHING SAND AND GRAVEL

Catalog 440, issued by the Link Belt Company, describes the theory and general equipment for washing, screening, and sizing sand and gravel, and lists the equipment manufactured in the different plants of the Link Belt Company and of the Raymond W. Dull Company, which has been acquired for the former. Descriptions of cylindrical and conical screens of various types are illustrated, all made with longitudinal joints enabling them to be installed for repair without disturbing the shaft on which several sections are continuously mounted. Besides screens made with circular holes punched in steel plates and forming simple cylindrical segments bolted together and to an inner framework, there are screens made with segmental flange plates bolted to an exterior framework having panels that can easily be replacd. Another type of screen is made with a basket work pattern of transverse and longitudinal bars bolted together for certain kinds of stone screens. Cylindrical scrubbers with lifting vanes to agitate the materials are sometimes installed at the upper end of a line of screens, the lower end of which terminates in an automatic conical and separator, which is made with diameters of 60 to 72 inches, having capacities of 650 and of 1,000 gallons of water per minute. There are special steel loading spouts and valves to be attached to storage bins and duplex screen gates for the same purpose.

The Style "D" improved drag line cableway excavator bucket is used for delivering sand and gravel to the washing plant and can be installed with a trolley operating on a cable run to the top of a mast and equipped with a two-drum hoisting engine. The bucket has a hinged rear end discharge gate which opens automatically when the dump trolley engages the dump casting, causing the wire rope connection to lift the gate. Steam hoisting engines, belt conveyors, bucket elevators, centrifugal pumping plants, storage bins, feeders for elevators and hoppers for loading and unloading



STYLE D. IMPROVED BUCKET



RECIPROCATING FEEDER

cars and trucks are illustrated. Locomotive cranes and grab buckets are also shown and a number of views are given of commercial sand and gravel plants equipped with Link Belt Apparatus.

CENTRIFUGAL PUMPS

Single gauge double suction volute centrifugal pumps, designed and manufactured by the Dayton-Dowd Co., are illustrated in bulletin 244, that gives specifications and descriptions of a large line of pumps fitted for water works, sewage, fire protection, circulation, boiler feed, hydraulic pressure, irrigation, booster service and other purposes. They are of the non-overloading pipe, designed so that the power consumed under any varying conditions will not exceed the power required under normal operation, and thus prevents serious overloading of the motor.

The bronze impellers of the enclosed double suctioned type have separate bronze wearing rims shrunk on the hub, and are enclosed in a main casing, the lower part of which is cast separate, integral with suction and discharge openings, while the upper part, which is flange bolted to it and easily removeable, forms a cover provided with water seals, vent and eye holts for lifting. The joint between the upper and lower part is gasketted, water tight, and perfectly aligned by tapered dowel pins.

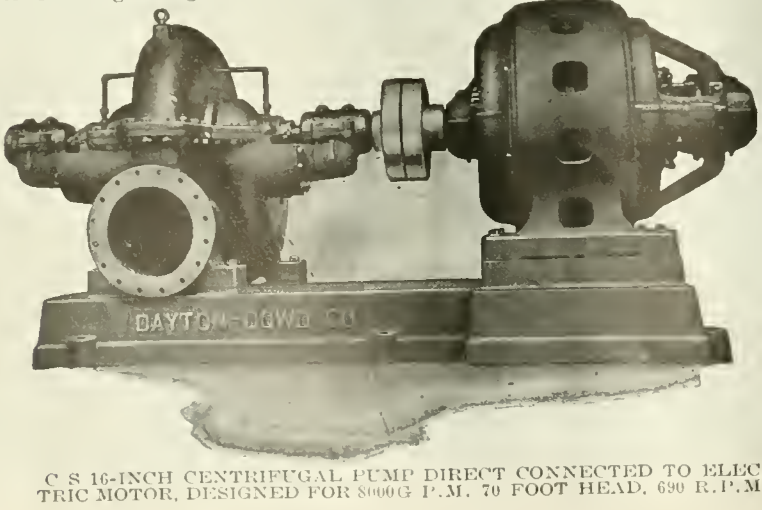
The pumps are well adapted for direct connection to electric motors and for small capacities against high heads, can be direct connected to steam turbines for single stage or for multi-stage service. They are also made with direct connection to gas engines and to be belt or gear driven. These pumps are suitable for delivering large quantities of water against comparatively low head for drainage or irrigation service. The catalog contains illustrations of various types and of installations of groups of pumps at the Hog Island Shipyard and elsewhere, and has convenient tables of speed, and of friction of water in pipes of ¾ to 48-inch diameter.

INDUSTRIAL NOTES

Edgar S. Genstein, formerly metallurgist for the Treadwell Engineering Company, Easton, Pa., is now head of the Technical Service Company, just organized at Allentown, Pa., for the purpose of furnishing consulting and sales service in chemistry and metallurgy.

The Byers Machine Co., of Ravenna, Ohio, has opened direct sales offices for its cranes and hoists; one at 30 Church street, New York City, with F. W. S. Elmes as district manager, and the other at 700 Rialto building, St. Louis, with Frank E. Miner as district manager.

The Clyde Iron Works Sales Co., of Duluth, Minn., has announced three new agency connections in the eastern part of the United States; these being Edelen & Co., Philadelphia, Pa.; Queen City Supply Co., Cincinnati, Ohio; and Waldo Bros. & Bond Co., Boston, Mass.



C S 16-INCH CENTRIFUGAL PUMP DIRECT CONNECTED TO ELECTRIC MOTOR, DESIGNED FOR 8000G P.M. 70 FOOT HEAD, 690 R.P.M.

The Rudolf M. Hansen Co., of Green Bay, Wis., has added to its present activities road construction and structural steel work, especially bridge construction, all of which will be in charge of F. A. Torkelson, formerly city engineer of that city.

The Harry M. Hope Engineering Co., of Boston, has established offices in Montreal to handle its Canadian business. George W. Saunders is Canadian manager.

The Tucker-Day Machinery & Supply Co. has been formed by George Day, formerly sales manager of M. Beatty & Sons, of Welland, Ont., and D. S. Tucker, of the Liberty Manufacturing Co., Pittsburgh. The firm, with head office in the National Building, Cleveland, Ohio, will handle a line of hoisting engines, derricks, locomotive cranes, wire rope and other contracting equipment.

The American-LaFrance Fire Engine Company has contracted with the Inter-State Machine Products Company, of Rochester, N. Y., for the exclusive sales rights on Sterling sirens for fire department use.

The Sterling siren possesses many advantages that cannot be obtained from a steam whistle or fire bell, and produces a weird noise that is instantly identified by all members of volunteer fire departments.

Connery & Co., Inc., Philadelphia, Pa., have just completed their plant after partial destruction by fire and are now on production basis again, having stocked over 600 kettles of all their styles ranging in capacity from 10 to 500 gallons. They have issued a new catalog and specification on their styles and are ready for immediate demands in any quantities. All their heaters are double electrically welded throughout and are guaranteed not to leak. A few of their styles are also being constructed with their new patented steel rib which had eliminated the buckling sides on certain types of construction.

The Good Roads Machinery Company moved its general sales office from 821 Bulletin building, Philadelphia, Pa., to Kennett Square, Pa., on June 25. All correspondence should be addressed to Kennett Square, Pa.

The Steel Fabricating Corporation has completed its new works and general offices at Michigan City, Ind., and has removed its executive headquarters from Harvey, Ill., to that city.

The last meeting prior to summer adjournment of the Engineering Advertisers' Association took place at the Great Northern Hotel, Chicago, on June 7th. Charles Piez, president of the Link-Belt Co., gave a talk on "Advertising and Selling from an Executive's Viewpoint."

The third annual convention of the National Lime Association was held June 15-17 at the Hotel Commodore, New York City.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.

Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 JULY 9, 1921 No. 2

Hetch-Hetchy Aqueduct Tunnel

Excavating, timbering and mucking in 10-foot 3-inch rock tunnel 18 miles Long. Construction from four portals and two shafts.

The Hetch-Hetchy reservoir in the Sierra Nevada mountains, in the valley of the Tuolumne river, 150 miles from the city of San Francisco, will impound 112 billion gallons of water to furnish daily supply of four hundred million gallons to the city and eventually to develop more than 280,000 h. p. of hydro-electric energy, utilizing only a fraction of the potential power due to the hydraulic head of about 3,600 feet between the dam and the city.

About twelve miles below the dam, at an elevation of 3,350 feet above the city, the water enters an aqueduct tunnel 18 miles long, which passes under two lofty mountain peaks in two sections about 4½ and 13½ miles long, separated only by a very narrow valley between the peaks.

EAST SIDE SOUTH FORK PORTAL

The tunnel, which is driven through rock, has a horseshoe shape cross section 10 feet 3 inches high and 10 feet 3 inches wide, is lined with concrete of a minimum thickness of 6 inches, has a cross sectional area of 87.94 square feet, and is designed to carry 400,700,000 gallons of water daily at a velocity of 7.15 feet per second.

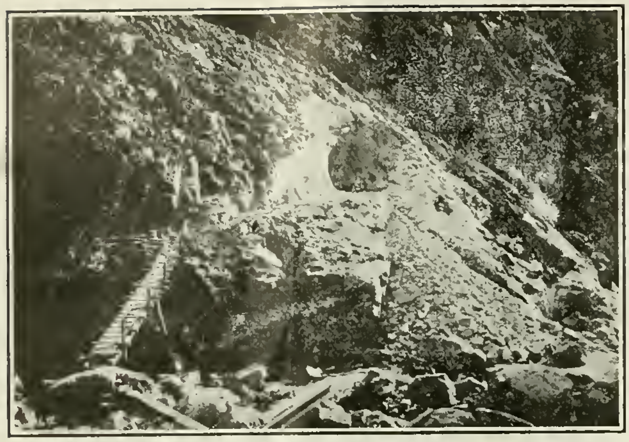
The neat line encloses a cross sectional area of 105.63 square feet, for which amount of excavation payment is made, amounting to 3.91 cubic yards per lineal foot of tunnel, with corresponding allowance of 0.655 yards of concrete lining, no payment being allowed for quantities outside the neat line. The hydraulic radius is 2.60 feet and the hydraulic gradient is 0.00125. The coefficient of roughness in the Chezy formula is assumed to be 0.014, and the constant g to be 125.5.

Where timbering is required, it is shown in the drawings as permanent 8-segment bents, clear outside of the neat line, and provided, where necessary, with permanent lagging.

Excavation of the short section of the tunnel is proceeding at the headings from the two portals only, because the depth of the tunnel below the surface of the mountain is too great for intermediate shafts. The longer section is under construction from the portals and from two shafts.

The rock encountered is very hard granodionite, schist or quartzite, requiring about 30 pounds of dynamite per lineal foot of tunnel. Full size headings are driven with 18 to 24 holes, charged with 70 to 100 pounds of 60 to 80 per cent dynamite, and making an advance of about 5 feet per round.

Abundance of standard plant has been installed, including motor-driven Laidlaw feather-valve compressors; rotary blowers with 20-inch air pipes; storage battery locomotives with charging apparatus; side dump, roller bearing tunnel cars; Water-Leyner, Sullivan and Waugh rock drills, and a Myers-Whaley mucking machine. The last is of sturdy construction with a very heavy bucket mounted on arms with both circular and straight line motions that enable it to simulate the operations of hand shoveling, the bucket first being crowded into the muck, then lifted, then moved backwards over the top of the machine and reversed, emptying into a short conveyor, which in turn discharges into the dump car at the rear. The machines are reported to effect considerable economy in handling the muck besides expediting the work by doing it much more rapidly than could be done by hand.

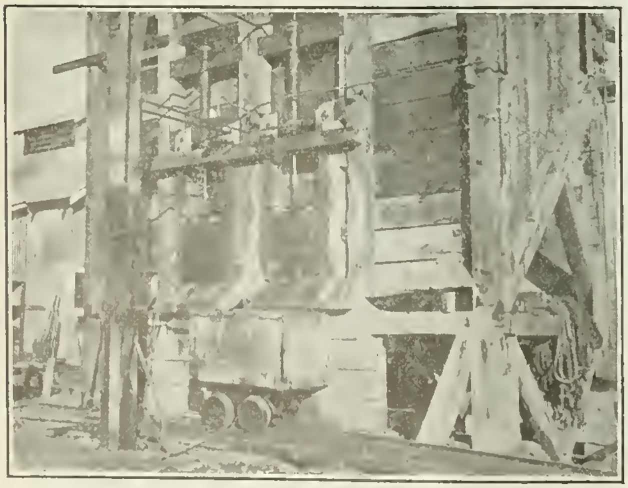


WEST SIDE SOUTH FORK PORTAL

Big Creek shaft, 575 feet deep to tunnel grade, has been extended 71 feet more to a total depth of 646 feet to provide for a sump and a dumping pocket where the muck is loaded by gravity from the tunnel cars to the hoists. Also a rock chamber has been excavated at tunnel grade alongside the shaft, to provide storage for equipment. Duplicate installations of double-drum, motor-driven, reversible hoists were installed at this and at the other shaft to provide for simultaneous workings from both headings. At the Big Creek shaft a heavy flow of ground water was encounterd 300 feet below the surface and was collected in a sump at a depth of 330 feet. Water entering below this level is separately collected in the lower sump and pumped the full length of the shaft.

The muck hoisted from the shaft is dumped into elevated storage bins with inclined bottoms and vertical sliding gates operated by pneumatic cylinders to deliver the muck to dump cars on the surface track.

The work is being executed under the direction of M. M. O'Shaughnessy, city engineer of San Francisco.



MUCK BINS WITH COMPRESSED AIR GATES AT BIG CREEK SHAFT

Increased Highway Construction in New York

Since January 1 the New York State Highway Department has let ninety-seven contracts for the construction of 387 miles of state controlled highways which will keep more than 7,000 men employed and represent a total cost of about $14,883,000. About 140 miles of road already have been finished, seventy-three of which are concrete 18 feet or more in width, thirty-five bituminous macadam and the remaining consist of other types.

It is planned ultimately to have approximately 11,000 miles of improved highways in this state, of which about 8,000 miles are now in existence. It is intended to complete the remaining 3,000 in six years. At present plenty of labor is available that is more efficient than for the last few years and can be hired, in some places, for 30 or 40 per cent less than last year.

Does State or Municipal Ownership and Operation Pay?

By Frederic I. Winslow[*]

An answer in the affirmative as shown in the experience of the Metropolitan District Commission of Massachusetts in the operation for ten years of two hydro-electric plants.

When the Wachusett dam at Clinton, Mass., was designed in 1895, there was planned a hydroelectric plant to be operated with the water sent to Boston, supplying that city and seventeen other municipalities. As this water is all sent through the older Sudbury system, there was also planned some years later to be installed at the Sudbury dam, a second power plant so that all the water would be twice used for power. The second plant was built 19 years after the gatehouse in which it was installed, and some very careful work had to be done to fit the machinery to the existing conditions.

The total amount of water now used daily naturally varies from week to week, but is about 127,000,000 gallons per day. The fall utilized at Clinton is about 96 feet, and at Sudbury dam, two falls of about 36 and 65 feet are utilized.

As is well known in water works practice, the loss of head between the source of supply and the point of final consumption is almost unavoidable, and is a cause of considerable anxiety to engineers. In this case the loss between the Wachusett reservoir at high water and Chestnut Hill, where the water reaches the pumps, is 260 feet. The Roman engineers overcame this difficulty by building their aqueducts at a straight grade, involving high structures across valleys and involving enormous expense, which would be prohibitory in these days. Of course the Romans also lacked the knowledge necessary to cast large pipes to cross valleys under a head, so that they had no alternative.

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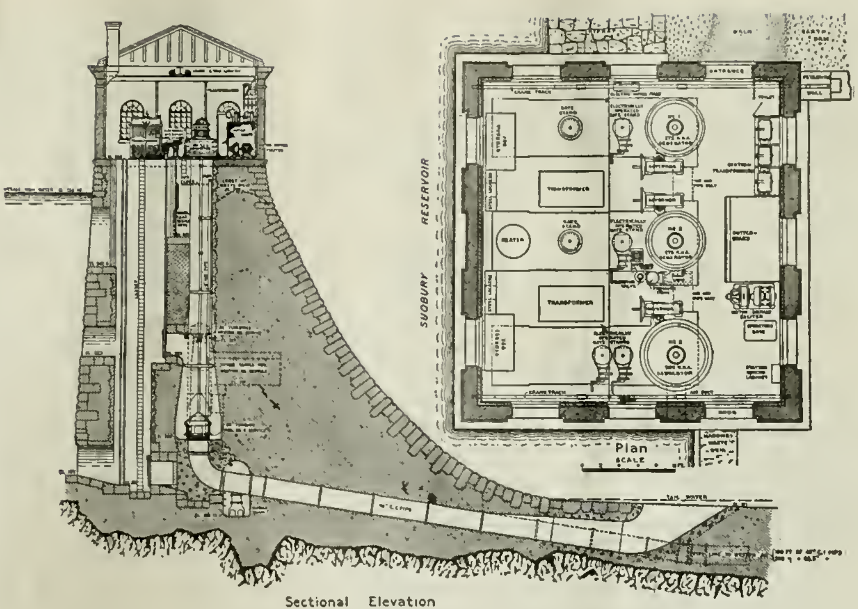
[*] Division and Consulting Engineer, Framingham, Mass.

At the Wachusett dam the larger plant of the two was built and put in operation in 1911. It consists of four 1,200 h. p. hydraulic turbine units, of the spiral case, horizontal shaft type, each directly coupled to a 1,000 kilowatt, 60 cycle, three phase, 13,800 volt, alternating current generator, to be used in exciting the main generator. The cost of this plant, including four Venturi meters, was $123,100.48.

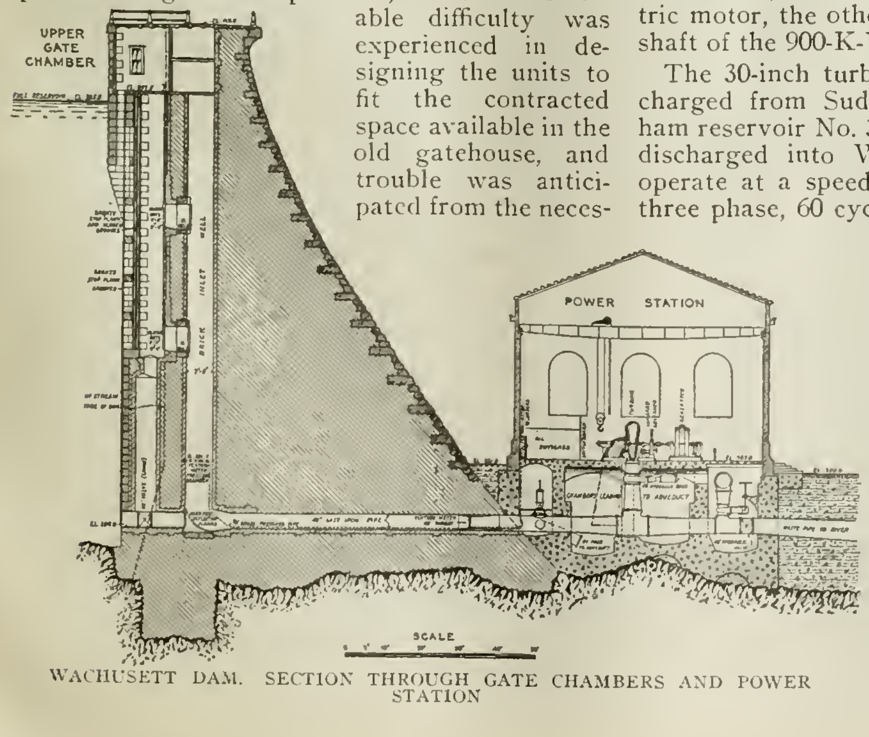


SUDBURY DAM. PLAN AND SECTION OF HYDRO-ELECTRIC PLANT

The receipts and earnings from this plant have been as follows:

Year	Receipts	Maintenance	Profit	Days Run
1912	30465.66	8995.66	21470.00	261
1913	33096.27	8989.75	24106.52	276
1914	38004.69	8969.46	29035.23	286
1915	26252.29	8125.47	18126.82	241
1916	34231.63	14633.72	19597.91	297
1917	37269.46	16948.98	20320.48	299
1918	44145.25	20522.49	23623.76	298
1919	40491.12	24162.36	16328.76	279
1920	51390.23	27778.14	23612.09	289

The plant at the Sudbury dam was finished and operation begun in September, 1916. Considerable difficulty was experienced in designing the units to fit the contracted space available in the old gatehouse, and trouble was anticipated from the necessity of discharging water from the wheels through long pipes at a high velocity, and the manufacturers refused on this account to furnish any guarantee of efficiency of wheels in place, and all invitations for bids on this basis were withdrawn and were later received under revised plans and specifications.



WACHUSETT DAM. SECTION THROUGH GATE CHAMBERS AND POWER STATION

This plant consists of one 30-inch 1,000 h. p., and two 24-inch, 300 h. p. vertical shaft, hydraulic turbines, directly connected to one 900-kilo-volt-ampere and two 275-kilo-volt-ampere alternating current generators.

Two 125-volt direct current generators are installed, each of sufficient capacity to furnish excitation for the three main generators under maximum load, one directly connected with an electric motor, the other directly connected to top of shaft of the 900-K-V-A generator.

The 30-inch turbine is operated by water discharged from Sudbury reservoir into Framingham reservoir No. 3 and the two 24-inch by water discharged into Weston aqueduct. The units operate at a speed of 360 R. P. M. and deliver three phase, 60 cycle, A. C. at pressure of 13,200 volts, to be stepped up by two 750-K-V-A transformers to 13,200 volts for transmission. The cost of this plant was $100,881.52, and it is usually run 15½ hours four or five days a week, and 24 hours the other days, not being run on Sundays or holidays, except in some extraordinary emergency.

The energy is sold at a price fixed with the understanding that the service is not continuous, and may be interrupted as required to conserve the water supply, or to maintain the water service into the Metropolitan District. The price at present obtained from the Edison Electric & Illuminating Company under a ten-year contract is $6.25 per 1,000 K. W.

The annual receipts and earnings from this plant have been as follows:

Year	Receipts	Maintenance	Profit	Days Run
1916	6663.21	3602.53	3060.68	90
From Sept. 14				
1917	18581.26			
1917	30962.47	18581.26	12111.21	304
1918	36125.39	19713.55	16411.84	315
1919	32736.59	17272.33	15464.26	303
1920	39892.71	19741.66	20151.03	305

The average earnings from both plants now is over $36,000 net. All figures include a proper allowance for depreciation and overhead expense. It should be, moreover, borne in mind that in both plants no men are kept excepting those absolutely needed.

The Philadelphia-Camden Bridge Over the Delaware

The state of New Jersey is engaged in two projects for carrying traffic across its river boundaries, from Jersey City under the Hudson river to New York at the northern end of the state, and from Camden to Philadelphia over the Delaware river in the southern part.

For the Camden-Philadelphia bridge the engineers' designs show a suspension bridge of 1,750 feet span, the longest ever built and estimated to cost nearly $29,000,000. It will have a capacity for six lines of vehicular traffic and four lines of rail traffic, the vehicular roadway being 57 feet wide and the total width of the bridge 125½ feet. The total live load provided for is 11,990 pounds per lineal foot. The clearance of the span above mean low water will be 135 feet and the height of the pylons 380 feet. It is hoped to have the bridge completed by July 4, 1926, the sesqui-centennial of the Declaration of Independence. The engineers selected as the Philadelphia terminus 6th street, between Race and Vine.

The double-track roadway will provide for pedestrian, motor and horse-drawn vehicles, railroads and trolley cars; the rail and trolley services being provided with spaces at each side of the lower roadway, while pedestrian promenades are located at each side of the upper roadway.

The engineers selected the suspension rather than the cantilever type largely because the former required a much smaller amount of metal —33,000 tons as against 47,000 tons. This saving was to some extent offset by a greater cost of anchorage structures for the suspension type but a balance of all arguments favored that type.

In planning the roadway widths, allowance of 9 feet 6 inches was made for motor trucks and six lines of traffic are provided for. The pedestrian promenades are each 10 feet wide. Two sets of tracks are provided for shuttle service across the bridge and two additional tracks for high-speed rail service. The approaches will be constructed on masonry supports, the space beneath offering possible opportunities for revenue-producing structures.

The towers supporting the cables will be of steel 16 feet wide at the top and 40 feet at the base. Each anchorage will require 90,700 cubic yards of masonry. The anchorages will embody the principal architectural features of the design. In order to insure an appearance of stability unaffected by elements, granite has been selected for the facing of the anchorages, the body of which will be of monolithic concrete, and reinforced concrete will be used for the roadway slab.

The board of engineers on the bridge design consisted of Ralph Modjeski, George S. Webster and Laurence A. Ball.

Fall Letting of Highway Contracts

A letter has been written by Stanley D. Moore, of the Moore-Young Construction Company, of Waterloo, Ia., to W. R. Neel, state highway engineer of Georgia and chairman of the Conference Committee of the American Association of State Highway Officials, urging the letting of contracts for highways in the fall rather than in the spring.

Mr. Moore classifies his reasons for this under six heads: (1) The greater abundance of open-top cars during the few months immediately preceding spring. (2) The closing of contracts in the fall would enable the contractor to perfect his organization and arrange for his storage and unloading during the idle winter months, thus permitting the early movement of aggregate during March, April, May and June, before the coal starts. (3) The same argument applies to moving cement and contractors' equipment in box cars before the grain movement begins. (4) Avoidance of the necessity of maintaining expensive lobbies and committees in Washington trying to get preferential rulings from the Interstate Commerce Commission, spreading the peak load and thus removing the fundamental cause of the trouble. (5) Any policy that will tend to increase the number of days during which a contractor can operate will enable him to spread his fixed overhead over a greater production and thus lower unit costs. (6) Low cost of roads can be obtained only by increasing production, and anything that increases the output per unit and spreads production over a longer period of time each year will result in decreased cost of cement, aggregate, transportation, and contractors' and supervising services.

In conclusion, Mr. Moore asks suggestions as to how to get the idea before the necessary authorities in time to get it into partial operation before next year.

The carrying out of this plan will involve the education of many people and legislative as well as executive bodies. For instance, legislators, budget committees, etc., must make their appropriations far enough in advance to permit definite plans to be made during the summer for the work of the year following so that these plans may be completed before the October letting. There is also the difficulty that these plans would ordinarily need to be completed during the season of the year when the engineering force of the highway department is most busy in its construction work, and would leave the force with little to do during the winter months after construction has ceased. However, there is in almost every state an abundance of work that has already been planned and for which, in many of the states, appropriations are already available, and if such work were let, as suggested, in September and October, it would greatly relieve the situation even if the remaining work were held over until early spring.

Refuse Disposal Contract for Boston

Principal features of a very complete contract for disposing of the garbage and rubbish of that city for a ten-year term.

As was noted some time ago in Public Works, the contractor for disposing of the municipal waste of Boston has stated that he is losing a large amount of money in carrying out his present contract, but apparently has concluded to carry it out until next July, when it expires. The city is about to advertise for bids for another contract beginning July 1, 1922, and continuing for a term of ten years.

Bidders are asked to submit, on September 6, bids for disposing of garbage alone, refuse alone, or both garbage and refuse. A bond will be required of $60,000 in connection with a contract for either garbage or refuse and of $100,000 for both. Bids submitted must be accompanied by a certified check for 10 per cent of this amount.

Garbage, for the purpose of this contract, is defined as including "animal or vegetable matter or the refuse thereof that has been used or intended for food, together with paper contaminated by food products, shells, tins, bottles, jars and other food containers; and refuse shall include the material removed from catch basins, street sweepings, grass, garden refuse and leaves, ashes, waste paper, cardboard, string, packing materials, sticks, rags, waste leather and rubber, boxes, barrels, broken furniture and other similar light or combustible refuse, tins, bottles, jars, broken glass, broken crockery, bones, shells, waste or broken metals, and all other similar heavy or incombustible refuse."

The garbage to be dealt with includes that from districts No. 1 to 6, inclusive, and the refuse that from districts No. 1, 3, 4 and 5. The city will deliver garbage to the contractor at three wharves. Refuse will be delivered at two wharves, or at a dump or dumps to be furnished by the contractor not more than ¾ of a mile from one of the wharves.

In the specifications the city endeavors to protect itself from various difficulties and from any suits by the contractor by stating definitely that it "does not represent itself to be the owner of the garbage or refuse, and it is understood that any independent disposal of garbage or refuse by the producers thereof shall neither make the city liable to the contractor nor be held to justify his default in fulfilling any of the requirements of the contract.

"The city reserves the right to dispose of any part or all refuse, from any district or districts covered by this contract, in any manner which it may elect other than by delivery to the contractor, and the contractor shall not hold the city liable for loss due to non-delivery of said refuse. Neither shall the city make any deductions from the contract price because of a reduction of the amount of refuse delivered to the contractor for disposal.

"The city shall have the right to dispose of refuse collected by it at any dump controlled directly or indirectly by the contractor, whether said refuse is collected within or without any district or districts covered by this contract."

Where a contractor for refuse disposal purposes to obtain an income from certain parts of the refuse, such as fat from the garbage or saleable material from the rubbish, complaint has frequently been made by such contractor that private individuals are allowed to collect the garbage richest in fats, thus depriving him of a prospective profit. In other cases, metals and other saleable materials may be held back from the rubbish. Or if the garbage is being fed to hogs, it is necessary that a certain minimum amount be collected every day in order to furnish a regular amount of food for the hogs, otherwise a substitute for the deficiency must be purchased. The contractor therefore would seem to have a just cause of complaint when his anticipated source of revenue in the refuse is thus diminished, but according to these specifications, the city of Boston will not hold itself responsible in any such event.

"For information and inspection of bidders, a copy of the report made by Messrs. Patterson, Teele and Dennis, auditors and accountants, covering the operations of the Boston Development and Sanitary Company for the disposal of garbage and refuse from January 1, 1913, to August 31, 1920, will be on file at room 508, City Hall Annex, Boston."

Bidders are asked to submit a lump sum price per year for a ten-year term, payments to be made monthly. The plant and equipment for final disposition must be tested and ready for operation not later than July 1, 1922; except that if the contractor intends to utilize the land, wharves, buildings, etc., on Spectacle island, where the plant of the present contractor is located, it will be necessary for him to provide some other method of disposal satisfactory to the commissioner for the time (not exceeding 6 months) which will be required for removing the machinery of the present contractor and installing his own.

Another important condition of the contract is the following: "The city reserves the right at any time during the life of the contract to discontinue stations or to provide other or additional stations. The city also reserves the right to deliver the garbage to the contractor, in whole or in part, in sealed metal receptacles, provided by the city, said receptacles to be taken to the disposal plant by the contractor without opening until their arrival at the plant. These receptacles must be cleaned by the contractor and returned promptly to the city. Failing agreement between the commissioner and the contractor as to any question of damage or increased cost alleged as being caused by such abandoned, substituted or added stations, or by the use of said receptacles, the matter shall be referred to arbitrators as hereinafter provided."

Certain other features of the contract are that the contractor must employ by preference citizens of Boston, next those of Massachusetts and third those of the United States; that he shall not require any employees to "lodge, board or trade at a particular place or with a particular person"; and that he shall discharge any employee who appears to the commissioner to be disorderly, careless or incompetent.

The specifications are unusually complete, covering the erection, equipment, maintenance and operation of the plant, vehicles, etc., necessary for transporting and disposing of the garbage and rubbish by whatever method may be selected by the contractor. Quite a full abstract of these will be given next week, as space is not available in this issue.

Trouble With Crustacea Organism on Filter Beds

By Helman Rosenthal*

Flea-like organism that swarmed in countless number killed by dosing the water with chlorine before filtration.

The Dallas, Texas, water purification plant receives its water from either of two sources. Elm Fork of the Trinity river is the more common one. But during the last two years we have received about 40 per cent of our raw water from Bachman's Lake, an artificial reservoir holding about 700,000,000 gallons of water. The water from this reservoir, which comes from natural springs and a small drainage area, is nearly always clear. Its turbidity for a long time is liable to be only one part per million. It is comparatively hard, about 150 parts per million, mostly bicarbonate alkalinity. This water is easily treated. However, at times this water carries a small flea about one-thirty-second of an inch long, and although the raw water has only a few, the water reaching the filters is at times full of them. They multiply very rapidly, and at times become so thick as to actually interfere with filtration. Washing the filters is only a temporary relief. At times they even work their way through the filters.

A study of the organism under the microscope showed the following characteristics. It is a long organism which swims on its belly. It has a very active tail, which moves up and down at "high speed." It has long legs, those in front are as long as the body. These legs have very definite joints, about 15 to 18. These legs have small branches like thorns on a rose twig. This flea seems to accomplish most of the swimming with these legs and tail. It has a sort of opal looking eye, which at times seems to be of a ruby red color. It has about eight legs, which resemble fins of a fish. When the drop in which the examination was made was almost gone by evaporation, the organism put up an awful struggle, and part of its head, which, by the way, is very defined, turned blood red, as if wounded.

Its tail somewhat resembles that of a fish, the part nearest the body is one narrow unit and it becomes fan shaped with about 10 or 12 ribs. It has a sort of elongated transparent protoplasmic movement from head to tail which terminates in a yellowish brown sack.

Some of these animalculae, which I presume are the females, have a sack hanging right under the tail. This sack contains about a dozen pea shaped cells. Each of these seem to have myriads of nucleii in them. Upon breaking up some of these cells innumerable nucleii spread in all directions. It is undoubtedly a crustacea organism and is similar, or perhaps the same as the Diaptomus Copepoda.

As stated previously, this organism at times becomes a real nuisance, and a method had to be devised to rid the filters of the pest. $CuSO_4$ suggested itself, but its use was somewhat expensive, nor was it very desirable. Finally the writer hit on an idea of chlorinating the water just before it goes to the filters.† The writer figured that the experiment was both harmless and inexpensive. We used from 0.5 to 0.7 parts per million of liquid chlorine. About three hours later samples of water from the filters showed the total absence of these organisms.

The writer feared that the strong chlorine solution might harm the biological activity going on within the filters, but the bacterial reduction showed that the fear was groundless.

The total expense was very small indeed, considerably less than copper sulfate would have cost and, of course, not in the least objectionable.

Shade Trees for Pennsylvania Highways

The State Highway Department of Pennsylvania began in June planting a large number of American elms and sugar maples along the state highway between Gettysburg and Harrisburg. The work is being done under the direction of the State Forestry Department.

State Highway Commissioner Sadler said that it is the aim of the department eventually to beautify all the main highway routes in Pennsylvania through the intelligent planting of shade trees. A plan has been worked out with the aid of the forestry department whereby a comprehensive system of planting trees along state highways will be taken up. The highway commissioner having designated the highway to be planted, the commissioner of forestry will inspect the highway, recommend the species to be planted and give in detail the planting operations, such as distance, care of stock, size and depth of holes, setting of the trees, fertilizers, staking trees, planting crew, necessary tools, approximate time required, and other details. State foresters will direct operations and inspect the trees from time to time.

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*Superintendent and Chief Chemist, Dallas Water Purification Plant. Paper before American Water Works Association.

†We always chlorinate the water after filtration, using about 0.2 to 0.4 parts per million of liquid chlorine.

In order to make a success of this work it will be necessary to obtain the hearty co-operation of the adjacent land-owners, obtaining their permission to remove undesirable trees along the highways if these are four inches or more in diameter at two feet above the ground. It will also be necessary to obtain the co-operation of companies operating overhead service lines. The trees will be furnished by the forestry department as rapidly as they become available from the state nursery.

Colloids in Tank Treatment of Sewage

At the convention of the American Water Works Association a paper was read before the chemical section by F. W. Mohlman and Langdon Pearse, chemist and sanitary engineer, respectively, of the sanitary district of Chicago, entitled "Colloid Chemistry and Its Relation to the Tank Treatment of Sewage." The authors state that within the last two or three years improved methods of study have been developed, and new processes of sewage treatment, such as the activated sludge and the Miles acid process, have had striking effect upon colloids in sewage. The purpose of the paper was to summarize the work that has been done and offer suggestions.

They stated that when activated sludge is in its best condition it will remove practically all the colloids from the sewage, but when underaerated apparently not all colloids are removed, and when over-aerated the sludge is more finely dispersed and is returned to colloidal condition in the effluent.

They describe the various methods suggested for the determination of the amount of colloids in a liquid, and call attention to the importance of developing some standard method.

Only a few experiments have been made on removing colloidal matter by tank treatment. Colloids will practically pass through and out of a tank within the usual flow periods of two to four hours employed in the settling chambers of Imhoff tanks. In the Travis tank an attempt was made to coagulate the colloids on the surfaces of colloiders or slats hung in the settling chamber spaced about three inches apart transversely and five to nine inches longitudinally. In the use of the Miles process or other application of acid to sewage, it is thought probable that the acids, which carry a positive electric charge due to hydrogen ions, neutralize the negative charges which the colloids are believed to carry and thus coagulate the colloids.

It is suggested that coagulation of colloids may also be effected by biological agencies, it being possible that in the activated sludge process enzymes have a clotting effect. Among the experiments by the Sanitary District was a so-called biolytic tank, in which all incoming sewage passed upward through the accumulation of sludge. Although septic action prevailed, with constant generation of hydrogen sulphide, a marked clarification resulted.

"Interesting developments may be hoped for in the application of methods of colloid chemical research to the problem of dewatering sewage sludges. For example, we do not know why fresh sewage sludge is so retentive of its water, while digested sludge parts with it so much more easily. The moisture content of Imhoff sludge varies widely with different sewages, and many problems in its digestion are still unsolved."

In conclusion, the authors believe that: "It is apparent that we are in need of: 1. A standard definition of the limits of size of colloids in sewage. 2. A standard method for the determination of sewage colloids. 3. The study of the effect of the hydrogen ion concentration on the removal of colloids, correlated with other determinations and observations which will prove the validity of such pH determination. 4. Tests of the practical application of precipitants which have been found effective in laboratory experiments. 5. Investigation of the principle governing the retention of moisture by sewage sludge.

Hamilton County Paving Plans

Hamilton county, Tennessee, by the middle of June had forces laying concrete pavement at the rate of about 500 feet a day. The policy of the present county administration is to add 10 miles of concrete highway each year if possible. This year's work is costing the county about $35,000 a mile. Of the cost of these county roads the state pays one-third and the federal government one-third. Hamilton county assumes responsibility for the remaining third, but expects to meet this without the expenditure of much cash except that required for purchasing equipment, the rental of which equipment will be credited to the county on the construction account. The county will also be credited with the convicts used on the work. Only about 30 free laborers are employed on the work, these being engaged as operators of steam cranes, concrete mixers, pumping plants, etc., and for placing the concrete forms and driving trucks. Machinery is used as far as possible, the mixers being fed by machinery and no wheelbarrows being used. The trucks receive the sand and gravel in the correct proportions and dump directly into the skip.

The pavement being built is one-course, plain concrete slab of 1:2:3 mixture, the coarse aggregate being Tennessee river gravel. The pavement is 16 feet wide with a 3-foot chert shoulder on each side, the concrete being 6 inches thick at the edges and 7½ inches at the center. Except at a few places where maximum grade of 6 per cent is reached, the grades run well under 2 per cent. No drainage structures worthy of mention are found on the entire right-of-way and many of the existing steel bridges will be used.

Ventilating the New York-New Jersey Tunnel

One of the weighty problems connected with the projected tunnel between New York City and Jersey City which has not been solved satisfactorily to all concerned was that of ventilation. It was felt that the passing of thousands of automobiles through the tunnel would make especially difficult the problem of keeping the air in the tunnel sufficiently pure for comfort and health. Investigations in ventilation have been carried on in the Pittsburgh district where a coal mine had been fitted up to duplicate as far as possible the tunnel conditions. Also a model of the tunnel is being prepared at the University of Illinois, with the ventilation apparatus installed. The chief engineer, Clifford M. Holland, stated recently that the results so far have proved "that we were over pessimistic in our tentative conclusions as to ventilation. No shadow of doubt now remains that we shall be able effectively to ventilate the tunnel with one-half the horsepower we had figured as required, pumping into the tunnel 3,500,000 cubic feet of air a minute and completely changing the atmosphere in the tunnel forty-two times an hour."

Applications for Positions

By Clarence D. Pollock

This is the season of the year when many applications for positions are received from young engineering graduates.

Judging from the character of many of them it would seem desirable that the engineering colleges give some instruction in this matter. The following is an example picked from a number of similar applications recently received which do not create very favorable first impressions:

> I wish to apply for a position in your company. I graduated from a reputable college and have had a large amount of study in all kinds of engineering and am therefore qualified for any position where I can use my engineering. I have had large experience with some very large concerns and would like a position in your office.

Many of these applications are less concise than this one, often repeating the same statements in several ways without telling any more about the candidate than does the above. If he had given the name of the "reputable college," the year in which he graduated, the titles of the positions he had held, the length of employment and names of the "very large concerns" for which he had worked, he would create a much more favorable impression.

The natural inference is that a man who submits an application in such general terms will require a great deal of training before he will be of much use. If he is sent out on inspection he is not likely to use much judgment as to what are the more important features and his reports will be too general and indefinite to be of any value.

Business schools and stenographic schools give instruction in the writing of applications for positions and it would seem desirable for engineering schools to do the same. Many times the applicant is a capable man, but through lack of a little instruction fails to think how the recipient of the application will have only his letter by which to judge of the candidate and if his letter tells him nothing besides the fact that he wants a job, he is likely to be passed by for some one who tells more about himself in his letter.

It is important for the candidate to make a good first impression by writing a concise letter which really tells something definite about himself and his qualifications.

Mortar Beds for Block Pavements

Editor, Public Works,
New York City.

Dear Sir: I have been very much interested in Mr. Howell's article on repairing Broad street pavement in Newark, and also in your editorial on the value of a mortar bed in block pavement. I can add to the information on this subject to the extent that we have found mortar beds in St. Louis, under both wood block and brick, which were later found to be of no more value than a sand cushion. We have also found mortar beds several years old which are almost as hard as the concrete base, and this applies to work adjacent to street car tracks as well as streets without tracks. During the past year I have made a very careful examination of mortar beds during and immediately after laying, and have reached the conclusion that the defective mortar beds were those which were laid with sand sufficiently damp to start up the setting of the cement immediately after mixing, and that a hard set had taken place before the street was rolled, but that the mortar bed was so weak at the time of rolling as to be completely broken up by the action of the roller. It has always been our custom in St. Louis to make the mortar bed dry and to sprinkle it *after* the rolling is completed. In analyzing our results I find that the strongest mortar beds were those which were laid in midsummer where the sand had been stored on the pavement in the sun, and was completely dry when mixed with the cement. Our most noticeable failures have been on work laid in the late fall when everything was wet. I am now requiring on sand-cement bedding courses that the sand must be reasonably dry when mixed with cement, and that, where possible, not more than an hour shall elapse between the mixing of the mortar bed and the rolling of the particular section of pavement. This, of course, requires that rolling work be kept up very close to the pavers.

Very truly yours,
W. W. Horner,
Chief Engineer, Sewers and Paving, City of St. Louis.

Philadelphia's Sewage Plant Dispute

Some time ago Philadelphia contracted with the Philadelphia Subway Construction Company to build what is known as the Northeast sewage disposal plant, the contract price being $1,025,000. More than a year ago the contractor gave up the contract and the city called upon the National Surety Company, its bondsman, to complete the work. This it refused to do and was placed on the blacklist by the city. Last December a proposition was before the council to pay the company an additional $350,000 for completing the work, in view of the higher cost of materials and labor. Later it was proposed that, in view of falling prices, this sum be cut to $275,000. A few days ago a joint committee reported to the council favoring the payment of the latter sum for the completion of the work.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba.$3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

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State Co-operation in River Control

In certain ways a river forms a convenient physical feature to serve as a boundary between states or other political areas, but in more ways watershed boundary lines or the summits of mountain ranges, where these exist, would serve the purpose better. For instance, if a river should flow through the center rather than form the boundary of a political area, the drainage of such area and the water supply would all be embraced within the political boundaries. With rivers as dividing lines between states, the authorities of such states find it necessary to agree upon united action or, as too often happens, appeal to federal courts for a definition or protection of their rights.

It is encouraging to note that co-operation rather than legal contest is being practiced by the governments of New York, New Jersey and Pennsylvania in most of their mutual relations with respect to water courses. Such is the agreement between Pennsylvania and New Jersey with a view to removing pollution from the Delaware river, and between Pennsylvania and New York with respect to the upper courses of the same river. Within a few days Governor Edwards, of New Jersey, announced his approval of a proposal by Governor Sproul, of Pennsylvania, for a conference of the governors of those two states and of New York to discuss flood control and the general economic importance of the rivers that affect these three states.

For Better Brick Pavements

"Too many construction jobs (of brick pavement) we have visited have displayed marked evidence of carelessness and lack of supervision and planning in the various operations involved. There has seemed to be lacking that interest, in all but a few notable instances, which results in good workmanship."

The Bureau of Public Roads began in the latter part of June taking photographs of actual construction of brick pavements with the purpose, we understand, of using this as part of an educational campaign for securing better highway construction. The Bureau has received the hearty co-operation of the National Paving Brick Manufacturers' Association, and its secretary, M. B. Greenough, has accompanied the representatives of the bureau for the purpose of selecting for photographing such work as would best serve as a model for showing how brick pavement should be laid. In Mr. Greenough's report to his association after a few days with the photographers, he makes the statement quoted above. As one item of faulty construction, he found "perfectly good brick going into a pavement with so much dirt stuck to them that no filler, either bituminous or cement, possibly could penetrate a joint."

From the organization of this association it has continually been one of the aims, and one greatly to its credit, to develop the best methods of constructing brick pavements and encourage the adoption of such methods. This, of course, is an intelligent effort towards benefiting the industry, since the best advertisement of paving brick is a good brick pavement.

It would appear from Mr. Greenough's remarks that too many engineers in charge of brick pavement construction are lax in securing a high or even reasonably good character of pavement construction, and Mr. Greenough can hardly be blamed for complaining that while "engineers have ever been ready to refine the product of the industry," "they have been singularly lacking in the share they could contribute to better brick pavements by enforcing good construction methods. From what we have seen, we should say that things are getting worse rather than better."

A good brick pavement requires something more than good brick; good construction can do as much to secure a perfect pavement and poor construction as much to produce an unsatisfactory one as can the furnishing of good or bad brick or other material entering into the construction.

Instead of conditions as to construction being worse than formerly, they should be better. Owing to the effect of post-war conditions on the industry, the cost of paving brick delivered on the street has increased more than that of most other paving materials. Since brick have become so expensive, it certainly would seem to behoove every city, county or state and the engineers representing it to take greater pains than ever to use this expensive material so as to obtain to the full the value which it is capable of giving.

It is to be hoped that, when the association finds any brick paving being done improperly, it will explain the objectionable features to the engineer in charge and that the engineers will receive these criticisms in a spirit of co-operation and endeavor to eliminate improper methods and secure in each case the best pavement the material is capable of. This, of course, should be the aim in all engineering construction, including pavements of whatever material, and broad-minded engineers will receive with thanks any suggestions which will aid in securing this end.

Planning Mechanical Equipment for a Road Job[*]

By C. D. Curtis[†]

It is unfortunate, but nevertheless a fact, that most jobs are equipped without giving to their planning and organization a proper amount of careful study. As a result expected profits shrink and may even become actual losses. Improperly equipped jobs can be classified under three heads:

1. Too much plant,
2. Lack of plant, and
3. Unbalanced plant.

With too much plant on a job the efficiency of operation is lowered, and although fairly satisfactory progress may be made, the cost will be too high. Rental or interest on investment and depreciation charges continue regardless of output. On an under-equipped job it is necessary to resort to labor which may be less efficient and more expensive. The progress of the work is likely to be delayed and total costs increased.

Of all the improperly equipped jobs the ones that have an unbalanced plant are probably most common. They are the inevitable result of equipping without planning. The several units making up the plant may be efficient mechanically when considered alone, but totally incapable of being worked smoothly and continuously together. On such jobs efficient operation cannot be secured. The plant investment might, and probably would, be higher than for a balanced plant. The season's profits however, are certain to be lower than anticipated.

CLASSIFICATION OF ROAD-BUILDING WORK

A classification of road-construction jobs based on the desirable and practicable rate of progress is feasible and would aid the contractor or engineer in selecting the proper plant. In determining on such a classification several factors would enter into the consideration, chief of which would be the size or length of the project. Another factor would be the problem of satisfactory detours and the probable economic loss to traffic. The cost, of course, would be affected by the classification. Ordinarily a higher rate of progress would be required on a large job than on a small one. The extra cost, then, of assembling and operating a large plant capable of rapid progress would be spread over a large yardage. It might easily happen, however, that the economic conditions would warrant requiring very rapid progress on a comparatively small job. This would change the classification and increase the cost of the work, but the bidder would know just what to expect.

In connection with concrete road jobs there might be three classes, such as:

A—Jobs on which equipment with a daily capacity of 1,000 feet of 18-foot roadway would be required.

B—Jobs on which equipment with a daily capacity of 500 feet of 18-foot roadway would be required.

C—Jobs on which equipment with a daily capacity of 250 feet of 18-foot roadway would be required.

In the case of Class A jobs it would ordinarily be desirable to equip with at least two complete operating units. This would insure continued, even though retarded, progress in the event of a breakdown of one unit.

Unnecessary refinements in the specifications which are met with at times usually lead to difficulties in operation and should, in the author's opinion, be avoided, especially where enforcement increases the cost of operation for minor or questionable benefits. There are, however, certain limitations which make necessary an intimate knowledge of the specifications under which work is to be performed. Examples of these limitations are:

1. Time limit on depositing of concrete after mixing. This limit would have a direct bearing on the location of central mixing plants and the equipment required for handling both the aggregate and the concrete.

2. Definite requirements relative to concrete mixers such as water-measuring devices, boom and bottom-dumping bucket, etc. Such requirements are small details, but must be met and so must be considered in selecting equipment.

3. Materials for concrete not allowed on subgrade. This feature is very important and makes necessary a careful study of the project in the field. Several alternative methods of handling the materials may be possible after a consideration of all the conditions.

SELECTING EQUIPMENT

In selecting equipment for a project, everything bearing on the situation should be considered.

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[*] Excerpt of paper presented at spring meeting of the American Society of Mechanical Engineers.

[†] Assistant to Chief, Bureau of Highway, United States Department of Agriculture.

The source of materials to be used, whether local or imported, condition of roads to be hauled over, width of available right of way, trackage and storage facilities available at receiving points for materials requiring rail transportation, maximum grades, water supply, availability of common labor and teams, and length of working season are some of the factors which should be looked into and studied before deciding on the type of plant to be used. In this connection the engineer may and should render all possible aid to the contractors. The preliminary investigations and detailed surveys made by the engineer give him much more information than the contractor can secure readily in his preliminary field inspection of the project. If the engineer knows that the conditions, even though not apparent, make the use of certain types of material impracticable, this information should be given to the contractor.

By arranging to ship and store materials during the season of light demand for open-top cars, for use during periods of car shortage, a continuous supply of materials can be secured. Such an arrangement may considerably alter the selection of equipment for handling the material. The extra cost of storing materials may be more than offset by the gain due to continuous operation during the construction season.

Where the materials can be unloaded from cars or loaded from the quarry or pit directly into containers for transportation to the job and in addition can be deposited in the mixer, in the case of concrete, without touching the ground, a great advantage is gained. In addition to being kept clean and free from mixture with foreign matter, the item of waste is very greatly reduced.

EXCLUSIVE DEVELOPMENT OF LARGE INDIVIDUAL UNITS UNDESIRABLE

In some states, by adopting the practice of letting large contracts for long stretches of construction work, large contracting companies have been induced to enter the highway field. They have brought trained operating organizations to the work and have put extensive road-building plants on their jobs. There is wisdom in such procedure whenever possible, for, of necessity, a great many road jobs are and will continue, for a variety of reasons, to be of comparatively short length. Letting contracts in both large and small sections gives both the small contractor and the large a field of operation and greatly expedites the carrying forward of a large program. The small contractor, acting as his own superintendent and operating with but little mechanical equipment, has but little overhead and can compete on a small job with the large contractor operating a large plant and carrying heavy overhead expenses.

Road building differs from most other construction activities in that the operations are conducted along an extended narrow path. The failure of one link may interrupt the work of a whole operating chain. This fact, in the author's opinion, makes the present tendency toward the development of large individual units somewhat questionable. When a large unit is used every precaution should be taken to insure its continuous operation.

IMPORTANCE OF MAINTAINING ORGANIZATION THE YEAR AROUND

One of the greatest handicaps which the road builder encounters in the northern states is the short construction season. Continuous operation is impossible and each season it is necessary to organize new construction forces. In the case of the skilled mechanics and foremen, an attempt should be made to retain their service the year around. They can be utilized during the winter in repairing equipment and putting it in first-class condition for the next season's work. The use of an extensive plant requires skilled operators, and, once trained, their services should be retained. Efficiency of operation in road work depends on the proper functioning of all the separate units. The mechanical units function properly only when properly handled.

On large jobs where more than one plant or complete operating unit is used, the spirit of the organization can be kept up by introducing friendly competition. The rivalry between two outfits to reduce costs and increase yardage has a very healthful effect on progress and incidentally on profits.

Cutting a 60-Inch Cast Iron Main With Oxyacetylene Torch

The proposed changes by the Baltimore Water Department in the distribution system at North avenue and Oak street required the removal of a 60 x 30-inch three-way and inserting of a 60 x 48-inch three-way and connections. As the operations of the Water Department were retarding the paving of the street, a method quicker than cutting the 60-inch cast iron pipe by hand labor was desired. An oxy-acetylene torch and operator were obtained through the local sales engineer of the Davis-Bournonville Company, and the cutting of the cast iron pipe was started immediately. The progress of the cut varied from .63 inch a minute to 1.3 inches a minute, the average being 0.7 inch a minute. The thickness of the cast iron pipe was 1.7 inches. Upon investigating the cut edges, small cracks were discovered around the entire circumference at intervals of 1.5 feet extending from ½ inch to 1½ inches from the face of the cut. This necessitated the removal of the pipe and the insertion of a new piece of 60-inch main. The new main was cut on the surface by hand labor, thus affording a direct comparison of the cutting of cast iron pipe by hand labor and with the oxy-acetylene torch. The following results were obtained. The cost of cutting the 60-inch pipe (2 cuts) by hand labor was $232.52, including labor, overhead, depreciation and the cost of sharpening the tools; whereas the cost of cutting the pipe (2 cuts) with the oxy-acetylene torch was $104.23, including labor, fuel consumed, depreciation and overhead, thus resulting in a saving of 55.2 per cent. The time saved was 62.1 per cent.

As the result of research work now being conducted by the engineers of the Davis-Bournonville Company it is possible that a practical way will be found for cutting cast iron pipe economically and quickly with the oxy-acetylene torch.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Drive Wooden Piles—II*

Drophammers, towers, cantilever and turntable drivers, penetration, steam hammers, double-acting hammers.

Where the work justifies it, much more rapid and economical results will be obtained by the use of a drophammer weighing from 2,000 to 5,000 pounds, operated by a steam hoisting engine installed in a movable timber tower a few feet higher than the longest pile to be driven. The tower usually has two vertical front legs about 4 feet apart transversely and two rear legs that are battered about 1 to 3 in the same longitudinal planes; all four legs being thoroughly braced together and mounted on a horizontal platform about 4 feet wide and 15 or 20 feet long that is braced to the rear legs and equipped at the rear end with a 2-drum, 2-spool hoisting engine, boiler and fuel and water supply.

The platform has full length longitudinal sills generally mounted on several wooden rollers 6 to 12 inches in diameter and 10 to 20 feet in length, with holes in the ends by which they may be revolved by capstan bars, moving the tower backwards or forward on the timber track laid on the ground to command the line of piles. The bearing of the sills on the rollers is usually in concave blocks that permit the tower to be moved lengthwise of the rollers, thus making transverse displacement from one row of piles to the next. Ordinarily the tower is about 50 feet high and with the hoisting engine and boiler weighs about 15 tons and may be shipped in one or two sections on flat cars. Larger ones must be partly disassembled for shipment and smaller ones may be transported on one or two automobile trucks.

CANTILEVER AND TURNTABLE DRIVING TOWERS

For driving piles on trestle falsework, viaducts, piers and various other positions where there is a long series of transverse bents 10 to 18 feet apart longitudinally, very good results are obtained with the cantilever driving tower which has the vertical posts mounted at one extremity of a long platform mounted on wheels and overhanging them one panel length, while the rear is counterweighted by the hoisting engine, boiler and other equipment, thus enabling the machine to drive a bent of piles in advance of the track, lay the track on it, advance to the next position, and so on. Such pile drivers are rather elaborate and costly and are sometimes provided with a turntable device that enables them to swing from side to side, driving several piles in the same transverse row from one position.

The vertical posts of the driver are provided with steel faced guides on their inner surfaces that engage slots in the hammer and keep it aligned. For operation at a considerable elevation above the surface of the ground these guides, called "leads," are frequently provided at the lower end with a detachable extension 10 feet or more in length, enabling the hammer to fall and the top of the pile to be driven below the base of the machine.

INCLINED LEADS

For driving inclined piles various arrangements are provided for tilting the tower out of the vertical or for pivoting the leads at the top and swinging them loosely to the required angle. In either case the efficiency of the drophammer driving is rapidly reduced with the divergence from the vertical, since only the vertical component of the weight of the hammer is effective and considerable friction must be overcome besides.

The hoisting engine should be rigged with an extra strong 1¼-inch diameter manila hammer line and the other drum with a wire rope, both of them led through sheaves at the top of the tower, the wire rope being used to handle the piles in the leads. A 4 or 6-part tackle is also convenient for hauling the piles along the ground to the foot of the pile driver and lines operated by the spools of the hoisting engine are very convenient for pulling the latter forward, backward or transversely.

WEIGHT OF HAMMER AND HEIGHT OF BLOW

Drophammers usually weigh from 1,800 to 4,000 pounds with the average size close to the upper limit, say about 3,000-3,500 pounds. The average drop of the hammer is about 10 feet, permitting the mechanical energy to be absorbed for useful effect in driving the piles. If it is very much less than this amount the blows are weak, and if it is much greater the momentum and velocity, increasing directly with the height, soon become so great that they cannot be wholly absorbed in useful driving and are likely to damage the pile, therefore the ordinary upper and lower limits of the drop are about 15 feet and 2 feet, respectively, with a maximum upper limit of about 25 feet. Under no circumstances is even a light hammer allowed to drop the full height of tall leads on a pile head because from a height of 50 to 60 feet it would shatter the pile.

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*Part I, General conditions and requirements, number, size, penetration, refusal, capacity, calculation, tests, pointing, cutting, banding and horse power was published June 18.

BLOWS AND PENETRATION

The average number of 10-foot blows of a drophammer vary from 15 to 20 per minute under favorable conditions, and a penetration of 30 feet may perhaps be produced in soft earth or clay by 60 blows, while 250 to 300 blows may be required for the same penetration in difficult material. The penetration, of course, varies between very wide limits, according to the nature of the soil, and may be entirely stopped by obstructions such as rocks, boulders, masonry, hardpan, old timbers and abandoned structures. Assuming that these do not exist but that the driving is free in a clear stratum, it is most rapid in mud, or silt, where a pile sometimes penetrates many feet under its own weight alone and then goes rapidly with gentle driving. In some cases if the penetration is rapid and continuous it may be several inches per blow at a depth of 60 or 70 feet and if discontinued for many hours the resistance from skin friction may be great enough to hold it immovable under heavy driving.

Most soil can be penetrated to considerable depth by judicious driving which must be varied according to the conditions. Sand and gravel are among the most difficult soils to penetrate and in order to penetrate 20 feet by hammer alone probably 600 blows would be required in coarse dry sand and much greater difficulty would be encountered in driving to a greater depth. The finer or wetter the sand the harder to drive through it.

STEAM HAMMERS

If a hammer is conveniently available or in any case if the driving is very heavy the use of a steam hammer, operated by steam or compressed air at a pressure of 100 pounds or more is very efficient and often enables piles to be driven and penetrations attained that are impossible with drophammers, chiefly because the very rapid action of the hammer keeps the pile in motion too continuously to prevent "set" and because the heavy load of the hammer continually imposed upon the pile facilitates driving.

Steam hammers are designed to fit directly on the head of the pile and may either be operated in the guides of an ordinary pile driver tower or may be handled by a derrick or any other convenient apparatus and seated directly upon the pile that is guided or otherwise held in position without guides, thus making it convenient to drive a large number of piles in a group with a hammer easily transferred from pile to pile after the latter are set in position. Often the hammer may be handled by a locomotive crane, by the boom of a stiff-leg or guyed derrick, which is likely to be necessary for other construction operations and thus obviates the necessity of providing a special pile driver tower.

The steam pile hammer is a steam cylinder and piston resting on the pile and delivering to it a blow with every stroke of the piston. In some makes the piston forms the hammer and in others the piston is stationary and the entire remainder of the machine serves as a hammer.

There are two principal types of steam pile hammers, the single-acting and double-acting. In the former the expansive force of the steam is used merely to lift the moving part that falls on the anvil with inertia due only to its own weight. In the latter the steam is admitted at both ends of the cylinder alternately, and not only lifts the

DRIVING PILES WITH DOUBLE ACTING McKIERNAN-TERRY STEAM HAMMER IN LEADS SUSPENDED FROM LONG DERRICK BOOM

DRIVING BATTER PILES WITH McKIERNAN-TERRY DOUBLE ACTING STEAM HAMMER

moving part, but drives it with full expansive force in addition to the weight of the falling body, thus producing more rapid and stronger action and using a larger quantity of steam.

The advantages claimed for single-acting hammers over double-acting hammers are the possibilities of somewhat fewer parts and greater simplicity, a reduced first cost, and a smaller consumption of steam power, which in the larger sizes may be only about 2/3 of that used by the double-acting hammers.

All the principal types of steam hammers are made in several sizes, of which the larger ones are chiefly intended for driving larger and longer piles, and for piles that penetrate very difficult soil. With the largest sizes of hammer of either type suitable piles can be driven to a great depth in any material, including hardpan and decomposed or soft rock. Steel piles have also been driven through large boulders which they split or have been driven until the lower end encountering an immovable obstruction has been deflected and forced upwards till it actually emerged above the surface of the ground.

Single-acting steam pile hammers weigh from 800 to 16,000 pounds, strike from 125 to 50 blows per minute and develop a variable foot-pound energy proportioned solely to the weight and length of stroke. The largest size is rated for a 40 h. p. steam boiler.

DOUBLE-ACTING HAMMERS

The double-acting pile hammer varies in weight from 145 pounds to 13,200 pounds, strikes from 500 to 140 blows per minute, and when supplied with steam at a pressure of 80 pounds per square inch, develops a maximum energy of 17,500 foot pound per stroke for which there is specified a 60 h. p. boiler.

Single-acting steam hammers have a lower cost and sometimes are of simpler construction than double-acting hammers and consume less steam or air power. The larger size requiring perhaps only about 2/3 as much as the double-acting hammers. They cannot drive piles when the latter are very much inclined from the vertical and they cannot be used for pulling piles. Double-acting hammers have smaller dimensions and are more compact than single-acting hammers, they strike more rapid and more powerful blows and can drive the piles through greater obstructions, can drive more linear feet of piles in a given time, can drive piles at any inclination with the same efficiency that they can drive vertical piles, and can be used with great efficiency for pulling piles. The larger the pile driven, the greater should be the weight of the hammer so as to overcome the inertia of the pile itself. A great advantage of all steam hammers is the minimum head room that they require, being able to operate in any place where they can be installed, and thus being efficient for working in and under buildings and in other restricted quarters.

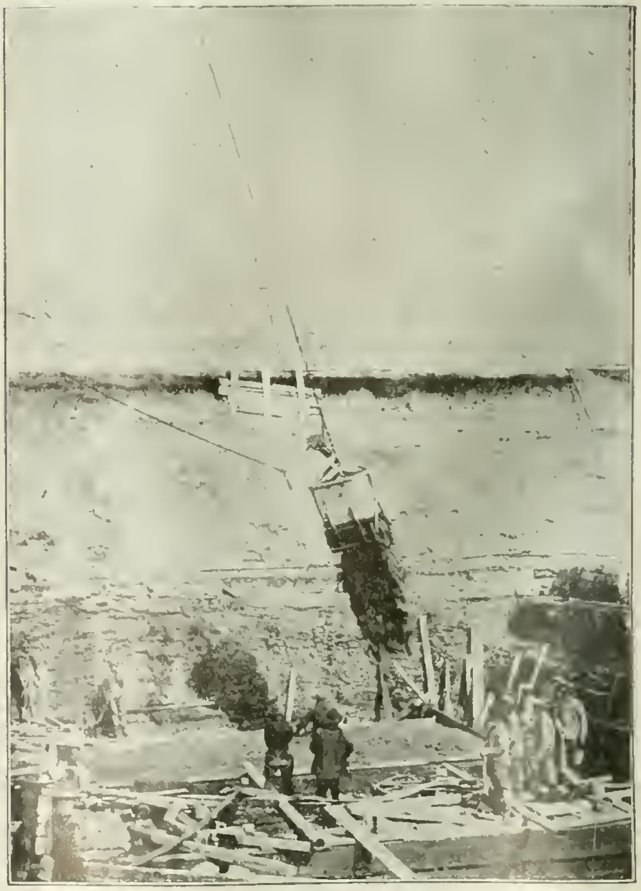
Lumber Production

According to a preliminary report of the United States Census Bureau the production of lumber in the United States was, in 1914, $715,310,000, and in 1919 it had increased to a valuation of $1,400,000,000. For the last ten years the production has decreased from 44,509,800 feet in 1909 about 22 per cent to 34,552,100 in 1919, when the production of yellow pine was 13,062,900, Douglas fir 5,902,200, oak 2,708,300 and Western yellow pine, hemlock and white pine each about 1,755,000 feet B. M. Since December, 1920, when the cost of lumber reached the highest peak at $37.27 it has declined 40 per cent.

A Skilful Derrickman

For the construction of the Lockington dam in the Miami Conservancy District, concrete was delivered to the forms in a bottom-flap steel bucket of 36 cubic feet capacity handled by a 105-foot boom steel derrick with a 120-foot mast.

In order to deposit the concrete at a point beyond the radius of the boom, the derrickman, Ed. Hines, alternately hauled and slacked the boom line in time with the swing of the suspended bucket until the latter moved outward on a long arc in a vertical plane radial to the derrick mast and finally at the extremity of its path was quickly dumped by tripping the bottom latch, allowing the 3 tons of concrete to shoot through the air to the required position in a line considerably inclined from the vertical. This operation skilfully performed enabled the last few yards of the concrete to be deposited without moving the derrick, which otherwise would have been necessary.



SWINGING DUMP FOR A CONCRETE BUCKET AT LOCKINGTON DAM

Recent Legal Decisions

STREET WIDENING BENEFITS EQUALLY PROPERTY ON BOTH SIDES OF STREET

Since street widening benefits affect alike all property similarly situated which abuts upon or is adjacent to the street and the benefits cannot be affected by the side of the street the job is on, nor by the fact that a "job" removed happens to be on one side of the street instead of on the other, Washington Supreme Court holds, In re Phinney Avenue, in City of Seattle, 194 Pac. 977, that an assessment proceeding which results in the assessment of one tract of property seven times as great as it does another of like area and situation, is unjust and arbitrary, and should not be allowed to stand.

TAXPAYERS CANNOT, THROUGH COURTS, INTERFERE WITH DISCRETIONARY POWERS OF MUNICIPAL AUTHORITIES

The Colorado Supreme Court holds, Antero & Lost Park Reservoir Co. v. Lowe, 194 Pac. 945, that where discretion may be exercised by a municipality, it must be done by constituted authority, and the courts cannot, at the instance of a taxpayer, interfere with the exercise of such discretion or substitute the judgment of the court for the judgment of those in authority. A taxpayer may protect the rights of the municipality against the unlawful increase of taxes which would throw an unlawful charge or burden upon his property, but he cannot by the exercise of discretionary power vested in others force additional burdens and taxes upon the taxpayers of the municipality.

MEASURE OF PAYMENT BY CITY FOR BENEFITS RECEIVED FROM PERFORMANCE OF VOID CONTRACT

The Minnesota Supreme Court holds, Fargo Foundry Co. v. Village of Calloway, 181 N. W. 584, that where a city or village contracts for a municipal improvement which it has power to make, but the contract is void because not made after competitive bidding as required by law the village is obliged to pay for any benefit it receives through performance of the contract, not because of the contract, but because of a general obligation to do justice. The measure of recovery is not the value of material and cost of labor, but the amount of benefit the village receives. If some part of the work is of value and another part a detriment, the net benefit is the measure of the city's obligation to pay.

CONTRACT NOT NECESSARILY ILLEGAL BECAUSE MATERIAL PURCHASED FROM MEMBER OF COUNCIL

The New Jersey Court of Errors and Appeals holds, Fredericks v. Borough of Wanaque, 112 Atl. 309, that, while a member of a municipal body who enters into a corrupt contract forbidden by the New Jersey Crimes Act, section 32, is guilty of a misdemeanor, and the contract itself is thereby void, yet in the absence of a corrupt understanding or agreement of the contractor with the member of the council voting for the contract to evade the act, a resolution of the municipality, otherwise legal, is not rendered illegal by the subsequent action of the contractor in purchasing his material from a recognized source of supply, the proprietor of which happens to be a member of the governing body which awarded the contract; and the contract itself does not thereby become nugatory.

"SITE OF WORK" IN CONTRACT FOR HIGHWAY CONSTRUCTION

Where a contractor for the construction of a highway has agreed with a sub-contractor to deliver materials at the "site of the work," the Maryland Court of Appeals holds, Fisher v. Vandewater, 112 Atl. 296, that it was the contractor's duty to deliver such materials at points on the highway where they were needed for the work in the course of its normal progress and not at some point thereon remote from the scene of the sub-contractor's operations.

STREET IMPROVEMENTS CAUSING INCREASED FLOW OF SURFACE WATER IN ADJOINING MUNICIPALITY

The Pennsylvania Supreme Court holds, Borough of Bridgewater v. Borough of Beaver, 112 Alt. 232, that, since every municipality has the right to the natural, proper and profitable use of its land if in the course of such use without negligence unavoidable loss is brought upon an adjoining municipality it is damnum absque injuria. Therefore where a borough has a legal right to open, grade, pave and improve its streets within a drainage area, and the owners of lots abutting on said streets have a right to erect houses thereon, fill up depressions therein and change the grades of their lots to conform to the changed grades of streets, damage to an adjoining borough by the increase in the quantity and velocity of surface waters drained into its streets by such street improvements is damnum absque injuria, which cannot be abated as a nuisance by the adjoining borough.

IN ABSENCE OF FRAUD OR AUTHORITY, PETITIONER FOR PAVEMENT CANNOT WITHDRAW AFTER APPROVAL BY CITY COUNCIL

The Nebraska Supreme Court holds, Wilkinson v. City of Lincoln, 181 N. W. 861, that in the absence of fraud or of statutory or municipal authority, a petitioner for a city pavement cannot withdraw his name after the petition has been duly approved and the pavement legally ordered by the city council. The court said: "The validity of municipal acts is not left to the changing attitude of private petitioners. Public policy [illegible] not permit a petitioner to invoke municipal power for the public welfare and, by withdrawing his name without specific statutory or municipal authority, destroy the power invoked by him after it has been legally exercised by the city council. This principle of municipal law is sound and is well established by precedent."

NEWS OF THE SOCIETIES

July 12-15—NATIONAL CONVENTION OF REAL ESTATE BOARDS. Chicago.

July 15—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Annual meeting. Crown Hotel, Providence, R. I.

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference. Hotel La Salle, Chicago, Ill.

Aug. 23-25—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS Annual meeting. Detroit, Mich. Secretary, Emmet P. Griffin, Superintendent of Park, East St. Louis. Ill.

Aug. 30-Sept. 1—MICHIGAN STATE GOOD ROADS ASSOCIATION. Annual meeting. Flint. Mich.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Treont Temple, Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta. Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building. Boston, Mass. Secretary, James F, Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS

The twenty-fourth annual meeting was held at the New Monterey Hotel, Asbury Park, N. J., June 20-24, 1921.

The first session was devoted to reports from the committees: On Coal, A. C. Fieldner, chairman; on Coke, Richard Moldenke, chairman; on Timber, Hermann von Schrenk, chairman; on Shipping Containers, J. A. Newlin, chairman; on Rubber Products, F. M. Farmer, chairman; and on Screen Wire Cloth, R. W. Woodward, chairman.

Second session: Report of committee on Preservative Coatings for Structural Materials, Allen Rogers, chairman; The Use of Secondary Reference Standards in Process Problems of Color Measurement, H. S. Busby; Stress-Strain Measurements on Films of Drying Oils, Paints and Varnishes, H. A. Nelson; Plastic Flow through Capillary Tubes, E. Buckingham; Textile Materials, A. E. Jeury, chairman.

Third session: Presidential address and reports of administrative committees, followed by an informal dance and smoker, Tuesday evening, June 21.

Fourth session, report of committee on Reinforced Concrete, Richard L. Humphrey, chairman. Progress report of joint committee on Standard Specifications for Concrete and Reinforced Concrete. A Proposed Method of Estimating the Density and Strength of Concrete and of Proportioning the Materials by the Experimental and Analytical Consideration of the Voids in Mortar and Concrete, A. N. Talbot. Time of Set of Concrete, Watson Davis. A Comparison of the Results of the Slump Test and the Flow Table in the Measurement of the Consistency of Concrete, W. L. Schwalbe. Variation in the Effect of Rodding Concrete, F. E. Giesecke. Testing of Plastic Calcined Magnesite for Use in Oxychloride Cements, M. Y. Seaton. Wear Tests of Concrete. D. A. Abrams.

Fifth session, report of committee on Road and Paving Materials, A. H. Blanchard, chairman. Tests for Soils with Relation to Their Use in the Subgrade of Highways, A. T. Goldbeck and F. H. Jackson. Measurements of Impact of Motor Trucks on Roads, E. B. Smith. Report of committee C-9, on Concrete and Concrete Aggregates, Sanford E. Thompson, chairman. A Study of the Composition of Blast Furnace Slags Suitable for Concrete Aggregate, L. G. Carmick. Fire Tests of Building Columns, S. H. Ingberg.

Sixth session, on ceramics, lime and gypsum. Report of committee on: Brick, H. T. Shelley, chairman; on Clay and Cement Sewer Pipe, Rudolph Hering, chairman; on Drain Tile, A. Marston, chairman; on Lime, H. C. Berry, chairman; on Refractories, W. H. Fulweiler, secretary; on Hollow Building Tile, W. A. Hull, chairman; on Gypsum, W. E. Emley, chairman.

Seventh session, on testing and nomenclature. Report of committee on: Methods of Testing, J. A. Capp, chairman; on Metallography, W. H. Bassett, chairman; on Nomenclature and Definitions, Cloyd M. Chapman, chairman; on Electrical Insulating Materials, F. M. Farmer, chairman; a Method of Determining the Tensile Strength of Porcelain, F. H. Riddle and J. S. Laird. Magnetic Spring Testing, T. Spooner and I. F. Kinnard; a Study of Elastic Viscous Deformation, P. G. Nutting.

Eighth Session, report of committee on Petroleum Products and Lubricants, C. P. Van Gundy, chairman. Refining of Petroleum, C. K. Francis. Improvements in Apparatus for Testing Petroleum Products, T. G. Delbridge. Problems Involved in the Development of Specifications for Motor Gasoline, E. W. Dean.

Presentation of a motion picture on "The Story of Petroleum," presented through the courtesy of the United States Bureau of Mines.

Ninth session, on steel and wrought iron.

Golf and tennis tournaments on Friday afternoon, June 24.

Tenth session, on cast iron, corrosion and non-ferrous metals.

The attendance of 610, only 10 per cent less than the highest previous record, was considered exceedingly good, especially in view of the high railroad fares. Abstracts of some of the most important reports of committees will be published in PUBLIC WORKS.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS

The committee of Paving Brick Specifications of the American Society for Municipal Improvements held a special meeting at Asbury Park, N. J., June 20, 1921. A revision of the brick specifications was discussed and E. S. Rankine, of Newark; W. P. Blair, vice-president of the National Paving Brick Manufacturers' Association; and Wm. C. Perkins, chief engineer of the Eastern Paving Brick Manufacturers' Association, were granted a hearing.

WESTERN SOCIETY OF ENGINEERS

At the annual dinner of the Western Society of Engineers held in Chicago on June 8, the society was addressed by the retiring president, Frederick K. Copeland, the incoming president, Charles H. MacDonweel and by Dr. R. A. Millikan on the "Organization of Research in a Democracy."

ROCHESTER ENGINEERING SOCIETY

At its annual meeting on June 10, the Rochester (N. Y.) Engineering Society elected the following officers: President, Harold O. Stewart; first vice-president, Charles C. Evans; second vice-president, Waldo G. Wildes; secretary, Gloster P. Havenor; and treasurer, Louis J. Summerhays.

NATIONAL ELECTRIC LIGHT ASSOCIATION

About 300 delegates were present at the annual convention of the North Central division of the National Electric Light Association, which was held in Duluth on June 21-23. Electrical manufacturers within a radius of 500 miles of this city sent exhibits to be displayed at the meeting. Other interesting features of the meeting were discussions on public utilities, general business conditions, fuel supply problems and similar subjects; tours about the city and visits to sources of power in the vicinity; also entertainments for the women of the party.

PERSONALS

Upham, Charles M., state highway engineer of Delaware, has been granted a year's leave of absence beginning September 1, to accept the position of state chief engineer with the state highway department of North Carolina.

Clark, B. E., acting state engineer and acting state highway commissioner of Oklahoma, has been appointed state highway commissioner of Oklahoma by Governor Robertson.

Harper, L. L., has been appointed city engineer of Quincy, Ill.

Givan, Albert, has been appointed city engineer of Sacramento, Cal.

Cogswell, William B., founder of the Solvay Process Co., at Syracuse, died at his home in that city on June 7.

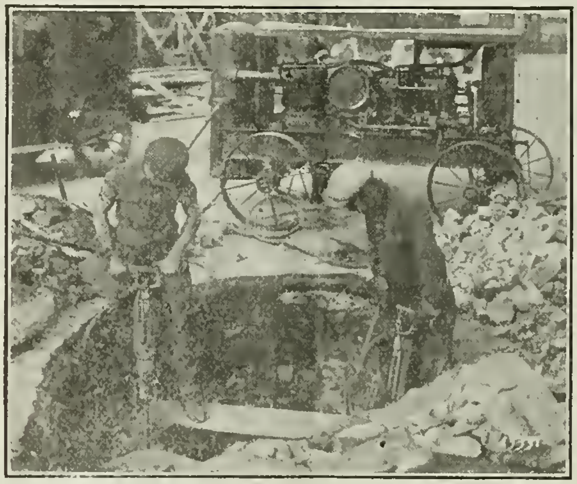
Boehringer, R. A., of the Akron, Ohio, water department, is now resident engineer of the Reading, Pa., water works.

Cauchon, Noulan, has been appointed chairman of the Ottawa Town Planning Commission.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

THE PAVING BREAKERS HAVE CUT THROUGH THE ASPHALT SURFACE, BROKEN UP THE CONCRETE SUB-BASE AND LOOSENED THE COMPACT SOIL


PAVING BREAKERS DESTROYING CONCRETE AND MASONRY FOR THE ENLARGING OF MAN-HOLE

PAVING BREAKERS

By the use of paving breakers, which are one-man pneumatic hand tools similar in construction to non-rotating hand hammer rock drills, operated by portable compressors, both manufactured by the Ingersoll-Rand Company and described in their bulletin entitled "Paving Breakers," it is claimed that asphalt and concrete pavements and the like can be cut for the installation of pipes, conduits and for repairs and new construction, with a saving in the cost of about 67 per cent and of time of about 75 per cent as compared with ordinary hand methods.

The breakers, which are of two sizes, weigh 58 and 68 pounds, respectively, are all steel, principally drop forged, and are of simple rugged construction with T handle in which is incorporated a simple trigger throttle valve. Undue shock is absorbed by the springs, and they are provided with bits having chisel edges for cutting asphalt, bitulithic block, etc., and a moil point for breaking or spawling concrete, loosening paving stones, breaking frozen or compact ground. The light machine is recommended for use with an air pressure of 80 pounds and the heavier one for pressures of less than 80 pounds.

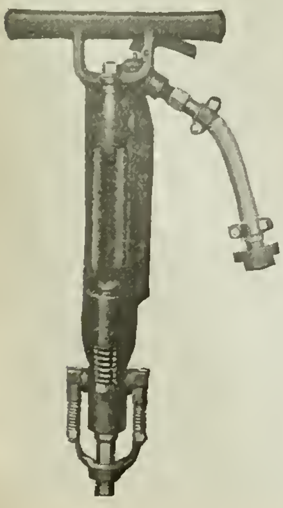
When the breakers are used for street railway work the air pressure is generally furnished by an Imperial tie tamper compressor and for other purposes, such as street paving, trenching and contract work, the Imperial Type 14 portable air compressor, driven by gasoline or electricity, is generally used. Any of these compressors will operate two paving breakers.

The average efficiency of good hand work in cutting through an asphalt pavement 3 to 6 inches thick and a 6-inch concrete base is about 10 linear feet per man per 8-hour day. Three men with a compressor and two paving breakers will average 300 linear feet of the same work in the same time, according to the record of a large eastern company using four of the outfits which they consider pay for themselves every month. One paving breaker and two men working for the Los Angeles Railway Corporation replaced 30 men, at $4.35 each doing the same work.

TURBIDITY AND COLOR INSTRUMENTS

Instruments for the accurate determination of the amount of color and turbidity in water, and for measuring them on standard scales are manufactured by the Builders' Iron Foundry, who supply turbidity apparatus recommended by the United States Geological Survey in Water Supply and Irrigation Paper No. 151 and in Circular No. 8 of the Division of Hydrography.

The instruments are based on the platinum-cobalt method of measure-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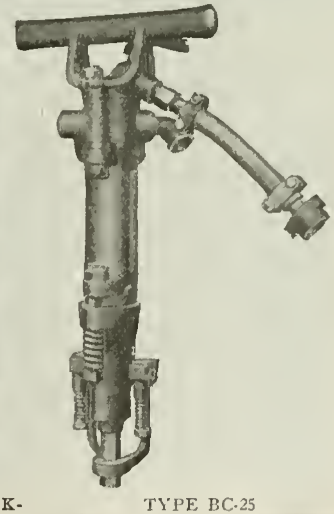
ILLUSTRATING THE APPLICATION OF PAVING BREAKERS ON ELECTRIC STREET RAILWAY WORK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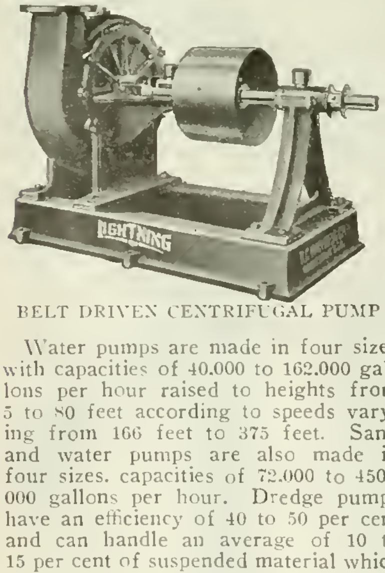
ment. devised by Allen Hazen, which compares the color of the given water with that of a standard Platinum-Cobalt solution, diluted to form a graded color scale, each solution being numbered to correspond with the number of parts of metallic platinum in 1,000,000 parts of the solution.

The apparatus consists of a tube containing 6 standard colored glass discs corresponding in color to the solutions indicated. There are three aluminum tubes, 50, 100 and 200 millimeters in length for containing the water to be tested.

The same company also manufactures a turbidity scale 8 inches long with an attached tape line which can be immersed in the water and will indicate the amount of turbidity by the depth of immersion necessary to cause a platinum wire at the bottom of a scale to become invisible. These instruments are especially valuable for use in designing filtration plants and for proportioning settling basins, for determining the slope of irrigation canals and for other purposes.

LIGHTNING CENTRIFUGAL PUMPS

Lightning centrifugal pumps have been manufactured for 25 years by the Kansas City Hay Press & Tractor Co. They have a runner with integral sides, the shaft is made with reversible ends, there is a special brass sleeve to prevent sand from entering the stuffing box and two collars to avoid end thrusts. The pumps can be changed from right hand to left hand, and are all constructed so as to discharge at any desired angle. A specialty is made of dredging pumps. The suction and discharge pipes are made of the same size and they are especially well adapted for pumping sand for dredging and filling.



BELT DRIVEN CENTRIFUGAL PUMP

Water pumps are made in four sizes with capacities of 40,000 to 162,000 gallons per hour raised to heights from 5 to 80 feet according to speeds varying from 166 feet to 375 feet. Sand and water pumps are also made in four sizes, capacities of 72,000 to 450,000 gallons per hour. Dredge pumps have an efficiency of 40 to 50 per cent and can handle an average of 10 to 15 per cent of suspended material which may increase to as much as 40 per cent under certain most favorable circumstances.

NATIONAL MULTIPHASE RENEWABLE FUSE

Electrical manufacturers have been working for years to develop a means to prevent Multiphase. (Polyphase) motors running single phase.

The Federal Electric Company of Chicago have developed, with basic patent protection, a low voltage auxiliary coil which is embodied in the renewable cartridge of National Renewable Fuses.

The new device serves two purposes: First, as a fuse it is so constructed that it withstands the high starting current of motors, yet protects the running load within the limits prescribed by the Underwriters' Laboratories, Inc.

As the fuse is made for operation on Multiphase circuit, it acts as a circuit breaker; that is, when one fuse blows, the auxiliary device in the National Multiphase Renewable Fuse makes one of the other elements in one of the other fuses blow, thereby breaking the circuit entirely and eliminating the possibility of the motor running as a single phase motor. This is really a time limit fuse and is absolutely fool-proof.

NEW ROAD MAINTAINER

A new machine just put into the road maintainer field is a one-man outfit departing entirely from familiar design, built with one front wheel and two large drive wheels in the rear, the grader blade being swung underneath and just in front of the operator, giving him a chance to see just what he is doing.

The only purpose of this machine is the proper and economical maintaining of dirt roads through the continuous system of road patrol maintenance, started in Wisconsin and rapidly spreading to all parts of the country.

The "One-Man" outfit, with its 6-cylinder motor developing 8 horsepower on the blade replaces two or three teams and two or three men. The operator sits at the rear of the tractor with the blade in front of and below him, so that he is sitting in a comfortable natural position and can see exactly what work is being done. The blade attachment is 12 feet long and is swung at an angle underneath the machine on a sub-frame which is bolted to the main frame. The blade itself, made in three sections, is adjustable both to the curvature of the road and the depth of the cut.

As the blade angles between the rear of the left drive wheel and the front of the right, it makes a cut 9½ feet wide. The outside right-hand blade is placed in a more angular position. In operation it thus keeps the dirt always rolling towards the center. This blade is especially convenient in cleaning out ditches or gutters.

In crowning a road the center of the blade is raised and the dirt will then roll to either side, leaving a smooth, perfectly crowned highway or street. Four levers, within easy reach of the operator, control the three sections of the blade quickly and easily.

This machine may be used for hauling loaded wagons, in construction work, or hauling scrapers and other road machines used in highway maintenance. It can also be equipped with a belt pulley for operating a small rock crusher or other belt machines.

The powerful 6-cylinder motor develops sufficient power for pulling the blade to any depth desirable. With the 3-speed transmission, it is possible to go over the road slowly when it is rough, and faster as it becomes smooth.

STOCKLAND ROAD GRADERS

The road grading machines described in the catalog of the Stockland Road Machinery Co. have been manufactured for 20 years, more than 1,000 are now in operation, and it is claimed that their use secures better roads and cuts the grading cost 17 per cent. An exclusive feature is the quick lift lever that makes the machine a non-stop grader by enabling the operator to lift the blade instantly and pass over any obstruction while the curved blades cut under the soil instead of scraping and pushing, and the steering device makes the control of the machine positive and easy. The blade can be shifted transversely, tilted at different angles, or completely reversed.

The graders are made in 6 sizes, the Giant of 25 h. p., weighing 8,200 pounds; Giant, Jr., 5,700 pounds; Special, 3,585 pounds; Standard, 3,100 pounds; Junior, 1,550 pounds, and the 1,000-pound Pony which can be operated by two horses. The new Giant is built for heavy road work to be hauled by a 30-60 or a 75-120 h. p. traction engine.

The Giant scarifier weighs 9,800 pounds, has 7 teeth 3½ inches square and cuts a swath 6 feet wide in macadamized, hard clay, or gravel roads. Any Giant Stockland grader can be converted into a scarifier machine.

The Northwest special drag is made by the same company in two sizes with blades 8 feet and 7 feet long, weighs 360 pounds and 335 pounds, respectively. The Northwest Junior drag is similar to the Special drag, but lighter.

TRADE PUBLICATIONS

FROM TREE TO TRADE

The Long-Bell Lumber Company has issued a handsome 46-page pamphlet richly illustrated with colored engravings that contains interesting and valuable statistics and descriptions under the head of The Forest Park Commission, Building, Modernizing a Great Industry, Community Life in the Lumber Industry, Life in the Logging Camps, Lumber in the Making, Quality in Lumber, Creosoted Wood Products, Finished Products from Western Woods, American Lumber in Foreign Countries, and Farm Lands in the Wake of the Woodman. Interesting details are given of the processes and equipment for logging, transporting and sawing lumber and interesting data regarding the products of the company which include Southern pine, lumber and timber, creosoted lumber and timber, oak and gum lumber and flooring, California white pine lumber and sash, doors and standardized woodwork.

TRAILMOBILES

Trailmobile Co., Cincinnati. Ohio, issues circular descriptive of trailmobiles, with four wheels, for hauling by teams, trucks and automobiles and of semi-trailmobiles with two wheels supporting rear end and a special bearing supporting the forward end on the rear truck of the automobile.

PUBLIC WORKS.

CITY **COUNTY** **STATE**

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 JULY 16, 1921 **No. 3**

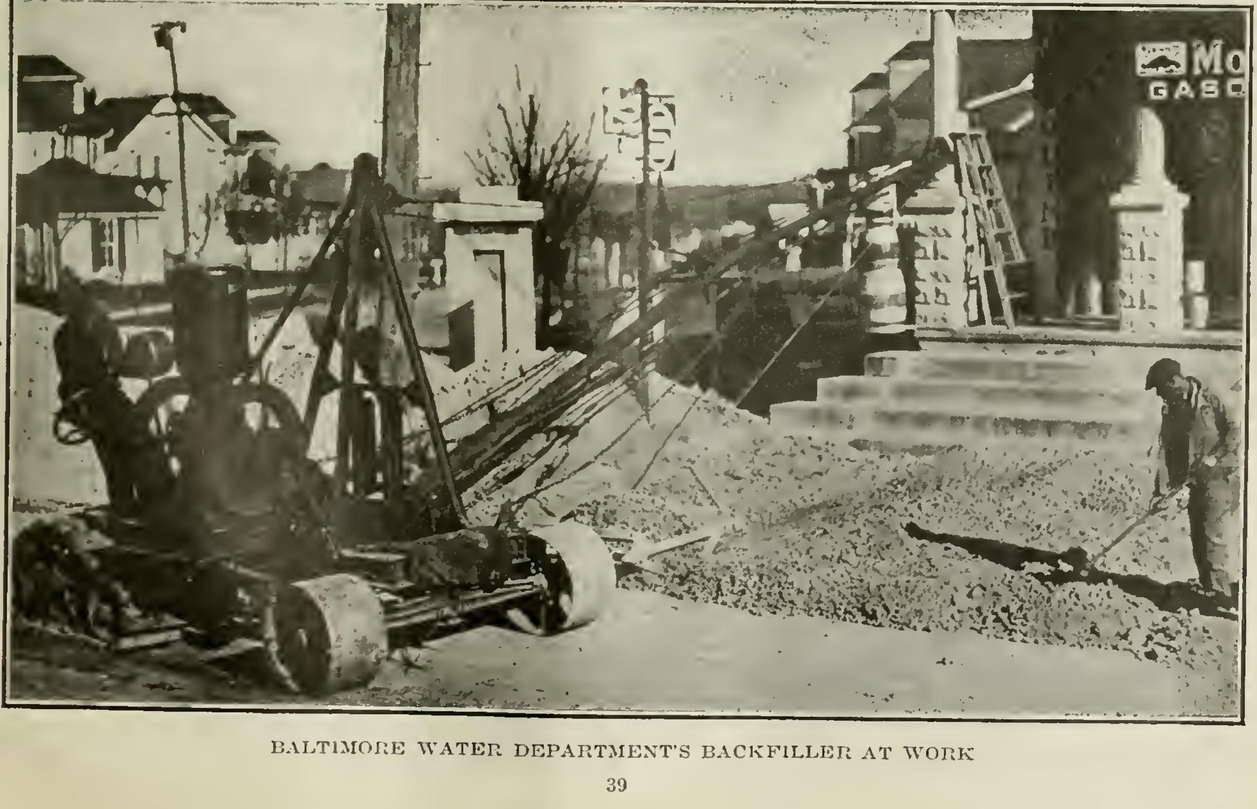
Mechanical Equipment of Baltimore Water Department[†]

By V. Bernard Siems[*]

Ownership and operation of trench excavators and other mechanical equipment by the Department. Performance and cost records given in great detail and compared with hand labor costs.

Machinery for excavating earth and other material has been recognized for years as more economical and efficient than manual methods where conditions will permit the use of such mechanical equipment.

In order to complete the construction of water supply and sewerage systems in the cantonments during the world war as quickly as possible, the United States Army used machinery entirely, and the results obtained have, no doubt, had a great effect on the increased use of trench excavators, cranes and backfillers by contractors and municipalities. The writer used trenching machines, cranes and backfillers entirely for the construction of the water distribution system for Camp Meade and Camp Franklin in 1918. The distribution system of Camp Franklin and the enlargement of the Camp Meade system were completed in 2½ months. Machinery of all characters was used to construct the intake and pumping stations and enlarge the filtration plant and balancing reservoirs at Camp Meade.



BALTIMORE WATER DEPARTMENT'S BACKFILLER AT WORK

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[*] Associate Civil Engineer, Baltimore Water Department.
[†] Paper presented at the 41st Annual Convention of the American Water Works Association.

In 1913 the engineers of the Baltimore City Water Department saw the necessity for obtaining a trenching machine, air compressor and pneumatic hammer to execute more expeditiously the work in connection with the installation of water mains. The Highway Department, in 1913, graded 33d street from Greenmount avenue to Hillen road, an approximate distance of 1.1 miles, preparatory to constructing a boulevard. The Water Department started the work of installing a 16-inch middle service water main by hand labor, and as the cost of doing the work was exceeding the estimated amount appropriated, the department engineers rented a trenching machine from the Consolidated Gas Company, and with the use of this machine the work was rapidly pushed to completion and the cost was less than the amount actually appropriated. This rented machine excavated 2,000 linear feet of trench, and the final cost showed that the excavating had been done at 16 cents a cubic yard. Based on this excellent showing, the Water Department was permitted to purchase a Parsons trench excavator, Model "K." Another important reason for permitting the purchase of a trenching machine was that the greater part of future water main installations would be in the northeastern and northwestern sections of the city where few, if any, subsurface structures would be encountered, and conditions would be ideal for operating trenching machines. The normal corps of fifteen laborers was too small to permit constant operation of the trenching machine in the work of laying water mains and backfilling, and it was necessary to increase the number of men. In order to still increase the amount of work and bring the water mains construction corps to the normal size of fifteen laborers, air compressors and pneumatic hammers were procured. This latter equipment was also necessary to secure uniform caulking of all pipe joints and thereby decrease the probability of leaks occurring after the laying of improved paving; it also reduced the time, and consequently the cost of labor, in caulking.

The first air compressor purchased was of Foster & Hosler make and had a capacity of approximately 80 cubic feet. Considerable difficulty was experienced in training the caulkers to use the pneumatic hammers intelligently in order to prevent breaking the bells of cast iron pipe. Tests conducted over a long period showed that pneumatic hammers should operate under a long stroke and at a moderate working pressure of 40 pounds per square inch.

The Engineering and Construction Division of the Water Department now has the following equipment.

Equipment	Original Cost
4 Air compressors (ranging from 80 to 210 cubic feet capacity)	$ 8,189
2 Backfillers	3,488
1 Austin 5-ton crane	8,095
1 Ransome concrete mixer	802
1 Air piling hammer	275
10 Ditch pumps	3,447
3 Trenching machines	23,794
Total	$48,090

From the accompanying table it is particularly noticeable that most of the machinery was purchased by the Water Department between the years 1918 and 1920. This table also shows the total equipment of the larger types of machinery now used by the Water Department.

TRENCHING BY MACHINE

Since the year 1914 the Water Department has used trenching machines under almost all conditions in the installation of water mains in public highways. The Parsons Model "K" trenching machine was put to a severe test at one time in excavating for the installation of a 4-inch water main in a private alley between ten and twelve feet in width. Difficulty was experienced in getting a trenching machine of this size in the alley, and damage was done to the wooden fences on each side of the alley. But even considering the difficulties and the expense entailed because of the damage done, the cost of installing the 4-inch main was much less than it would have been if done by manual labor. It may be interesting to note that a comparison of the cost of doing work in private alleys of various width and public highways, whether done by manual labor or by trenching machine aided by hand labor, shows

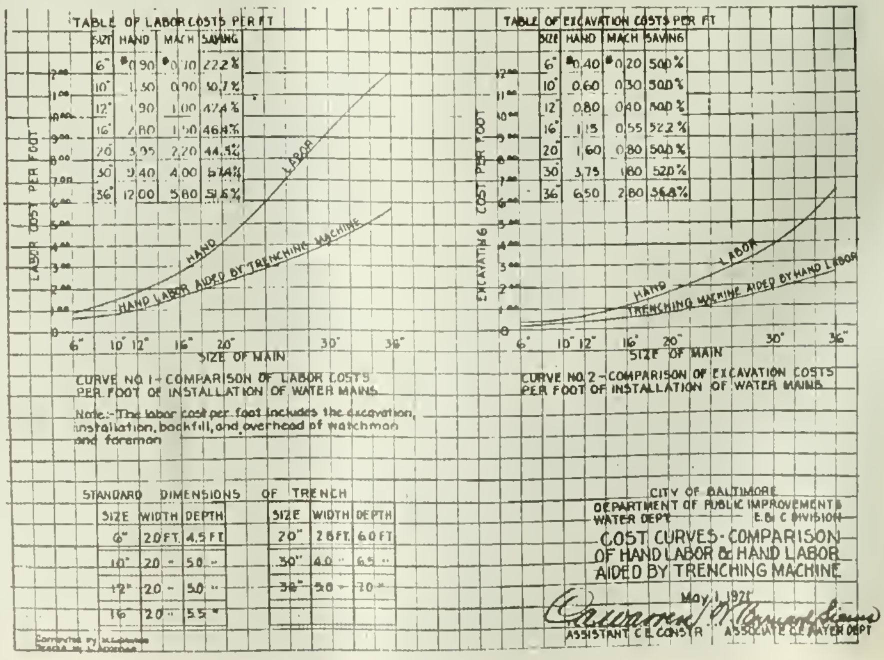

TABLE OF LABOR COSTS PER FT

SIZE	HAND	MACH	SAVING
6"	$0.90	$0.70	22.2%
10"	1.50	0.90	40.7%
12"	1.90	1.00	47.4%
16"	2.80	1.50	46.4%
20"	3.95	2.20	44.5%
30"	9.40	4.00	57.4%
36"	12.00	5.80	51.6%

CURVE NO 1—COMPARISON OF LABOR COSTS PER FOOT OF INSTALLATION OF WATER MAINS

Note:—The labor cost per foot includes the excavation, installation, backfill, and overhead of watchman and foreman

TABLE OF EXCAVATION COSTS PER FT

SIZE	HAND	MACH	SAVING
6"	$0.40	$0.20	50.0%
10"	0.60	0.30	50.0%
12"	0.80	0.40	50.0%
16"	1.15	0.55	52.2%
20"	1.60	0.80	50.0%
30"	3.75	1.80	52.0%
36"	6.50	2.80	56.8%

CURVE NO 2—COMPARISON OF EXCAVATION COSTS PER FOOT OF INSTALLATION OF WATER MAINS

STANDARD DIMENSIONS OF TRENCH

SIZE	WIDTH	DEPTH	SIZE	WIDTH	DEPTH
6"	2.0 FT.	4.5 FT.	20"	2.6 FT.	6.0 FT.
10"	2.0 "	5.0 "	30"	4.0 "	6.5 "
12"	2.0 "	5.0 "	36"	5.0 "	7.0 "
16"	2.0 "	5.5 "			

CITY OF BALTIMORE
DEPARTMENT OF PUBLIC IMPROVEMENTS
WATER DEPT E. & C DIVISION
COST CURVES—COMPARISON OF HAND LABOR & HAND LABOR AIDED BY TRENCHING MACHINE
May 1, 1921
ASSISTANT C.E. CONSTR ASSOCIATE C.E. WATER DEPT

FIG. 2. INSTALLATION COST CURVES—HAND LABOR VS. HAND LABOR AIDED BY TRENCHING MACHINE

Table No .1
Method of Ascertaining the Cost per Hour of Operating Machines

Type of machine	Designated as	Original cost	Probable life	Date of delivery	Probable No. of hours in operation per year	Depreciation cost per hour	Fuel consumed cost per hour	Probable repair per hour	Total cost per hour	Operator's cost per hour	Total operat'g cost per hour
Air Compressors:											
Ingersoll-Rand	A.C.1	$3,058	5 years	Nov., '20	2,000	$0.31	$0.61	$0.08	$1.00	$1.00	$2.00
Sullivan	A.C.2	2,531	5 years	Dec., '20	2,000	0.25	0.61	0.09	.95	1.00	1.95
2 Foster & Hosler	A.C.3&4	1,300	5 years	Mar., '18	2,000	0.13	0.15	0.02	.30	1.00	1.30
Backfillers:											
Backfiller M.5	B.1	847	5 years	Oct., '18	800	0.21	0.11	0.10	.42	1.00	1.42
Backfiller M.10	B.2	2,641	5 years	Oct., '20	800	0.66	0.37	0.10	1.13	1.00	2.13
Crane:											
Austin	C.1	8,095	5 years	Aug., '19	1,000	1.62	0.96	0.20	2.78	1.00	3.78
Concrete Mixer:											
Ransome	C.M.1	802	5 years	Oct., '20	800	1.00	0.23	0.02	1.25	1.00	2.25
Hammer:											
Air Piling	A.H.1	275	5 years	Mar., '20	250	0.22		0.03	.25	1.00	1.25
Pumps:											
3-No. 00 4 h.p.	P.1	390	3 years	Mar., '19	2,000	0.07	0.19	0.04	.30	1.00	1.30
3-No. 00 2½ h.p.	P.2	349	3 years	Apr., '19	2 000	0.06	0.19	0.04	.29	1.00	1.29
1-No. 00 Centrif.	P.3	490	3 years	Feb., '19	2,000	0.08	0.19	0.04	.31	1.00	1.31
1-Domestic	P.4	180	3 years	Feb., '19	2,000	0.03	0.19	0.03	.25	1.00	1.25
1-Schramm	P.5	280	3 years	Feb., '19	2,000	0.05	0.19	0.04	.28	1.00	1.28
Trenching Machines:											
Parsons Model K	T.M.1	5,542	5 years	Apr., '14	1 456		1.39	0.31	1.70	1.00	2.70
Parsons Model 24	T.M.2	8.052	5 years	Dec., '20	1,456	1.12	0.63	0.25	2.00	1.00	3.00
Parsons Model 36	T.M.3	10,200	5 years	Apr., '20	1.456	1.40	1.39	0.25	3.04	1.00	4.04

Columns Nos. 1, 2, 3, 4, 5, 6, 10, 11 and 12 are self-explanatory. Column No. 7—Column No. 3 divided by column No. 4, equals depreciation cost per year, and this quotient divided by column No. 6 equals depreciation cost per hour. Column No. 8—Fuel consumed per hour was ascertained by test on each machine and is approximately as follows: 90 per cent gasoline, 3 per cent grease and 7 per cent lubricating oil. Column No. 9—Yearly cost of repairs for each machine divided by column No. 6 equals repair cost per hour.

that the cost of the installation in private alleys is twice that of the cost in public highways. The Water Department, therefore, does not even consider the installation of water mains in private alleys. Judging from our records of cost, such installations should be discouraged by all municipalities.

Trenching machines have also been used to remove the cover of all sized water mains where it has been found necessary to enlarge or replace them by other mains, particularly so in cases where it is necessary to lower the water mains because of a change in the grade of the public highway.

In the residential and business districts where it would be economical to excavate trenches with trenching machine for installation of water mains, accurate locations were obtained of water supply, gas supply and other services in advance of the work. The locations of these services were marked on the curb line, and the trenching machine operator very seldom disturbed any of them as he raised the boom of the machine as it approached these marks. It was, of course, necessary to do the extra excavating around the service pipes by hand labor. In other instances the Department has found it economical to disconnect these services temporarily, in order to provide clearance for the operation of the trenching machine. Even with these additional costs, there was considerable economy in the use of the trenching machine, especially on the installation of large water mains. From our cost data records it is estimated that damages to subsurface structures by the use of trenching machines approximate 1 per cent of the total cost of the installation of the water mains.

OTHER MACHINERY

In 1918, due to the increasing number of extensions of water mains, the scarcity of labor and the high rate of pay necessary because of the salaries paid labor by industrial plants in and around Baltimore, it was decided to purchase additional trenching machines, a 5-ton Austin crane and backfillers. The cost of installing water mains was materially lessened by the use of this machinery in the years 1919 and 1920. The 5-ton crane saved us considerable money, as we handled practically all cast iron water pipe and fittings of 20 inches and over with it. Two types of backfillers are used—one the boom drag and the other the scraper drag. The boom drag is used on the backfilling of trenches for large mains and the scraper drag on smaller mains in territories where the Highway Department will permit backfilling of ditches by puddling the material. We have, however, also used it in public highways where ramming was necessary. Tests made with me-

CRANE HANDLING LARGE SPECIAL CASTING

chanical tampers have not shown satisfactory results thus far. It is hoped that they will be developed to the extent of the other machinery now used by the Water Department. We have a much larger equipment of machinery than that noted in table No. 1 in machines of a smaller character which we purchased from time to time and which are not shown on the table. I believe that the Water Department of the city of Baltimore ranks first among the American municipalities in the use of machinery for doing the work in connection with the installation and maintenance of a water distribution system.

ORGANIZATION FOR OPERATING AND REPAIRING EQUIPMENT

The operating and repairing corps of the mechanical equipment used by the Construction Subdivision of the Engineering and Construction Division is organized as follows: The associate civil engineer of the Water Department is in charge of the division, and under him is the assistant civil engineer in charge of the construction subdivision and the automobile repair man in charge of mechanical equipment. The repair corps is divided into five units, each containing an automobile repair man who receives $.66 an hour, and a handy man who receives $.50 an hour on three of the units and $.45 an hour on the other two. The first unit has charge of backfillers Nos. 1 and 2 and trenching machine No. 1; the second unit has charge of air compressors Nos. 1 and 2 and trenching machine No. 2; the third unit has charge of air compressors Nos. 3 and 4 and trenching machine No. 3; the fourth unit has charge of gasoline pumps Nos. 1 to 6, inclusive and crane No. 1; and the fifth has charge of gasoline pumps Nos. 7 to 10, inclusive, and concrete mixer No. 1. The automobile repairman, grade No. 1, in charge of mechanical equipment, reports directly to the assistant civil engineer in charge of the construction subdivision or his assistant, the same as the water pipe construction foremen do; the five automobile repairmen, grades Nos. 2 and 3, are subordinates, being assisted by handymen, and to each group is assigned equipment which they operate and maintain.

The City Service Commission of Baltimore requires that an automobile repairman must have an elementary education, several years' experience in assembling or repairing and operating gas engines and other mechanical equipment. For handyman it requires an elementary education, one year's experience as general handyman in a machine shop and ability to follow instructions from an automobile repairman. The handymen are also used for burning out lead in cast iron pipe bells on mains of the larger size. From experience it has been found that the best men available for positions of automobile repairmen are those advanced from the position of handyman.

Experience in the use of mechanical equipment has proved to us that it is more economical and efficient to have a storage of duplicate mechanical parts available for any emergency than to order the repair parts when needed. The automobile repairman, grade No. 1, in charge of mechanical equipment is held responsible for stock parts of mechanical equipment, and also for repairs to machinery. After the completion of the work the machinery is inspected thoroughly before being transported to another location, and, therefore, it is always in good working condition to commence the next work.

(To Be Continued)

Boston's Refuse Disposal Specifications

Principal features of specifications on which Boston expects to let contract in a few weeks. Removal and disposal by alternative methods.

Last week we gave in abstract the principal features of a form of contract upon which the city of Boston is inviting bids for disposing of its refuse. In the following paragraphs will be given the more important features of the specifications accompanying said contract.

In both contract and specifications the word "refuse" has been used where we think better practice would use the word "rubbish," "refuse" being generally applied so as to include all kinds of waste material including both garbage and rubbish. However, the word has been used herein as in the Boston specifications to include only refuse materials other than garbage.

The contractor is required to dispose of all garbage and refuse delivered to him by either the city or a contractor hauling material for the city, and also of "all garbage and refuse delivered to him by the producers or private collectors at any collection station, provided he is paid by such producers or private collectors for such disposal at a rate not exceeding five cents per barrel of four cubic feet."

The city contemplates continuing the present practice of having garbage placed in one receptacle and all other household wastes in another; except that in portions of four of the districts a third separation is made of paper, wooden and paper boxes, excelsior and other light materials. The city will secure as complete a separation of materiasls as it may find to be practical, but any failure on the part of householders or others to separate the materials will not be held to justify the contractor's default in fulfilling any of the requirements of the contract.

Garbage and refuse will be delivered at several stations whose locations are specified. "No putrescible material shall be allowed to remain in the stations beyond 7 o'clock a. m. of the day succeeding its delivery, and all garbage and refuse shall be removed from the stations as soon as possible. In no case shall the stations be used for storage of saleable material by the contractor, nor shall such material be allowed to collect so as to interfere with the operation of the city vehicles . . . No sorting of garbage or refuse or any operation of final disposal shall be conducted at any receiving station."

For removing material from wharf stations the contractor must use scows of a design satisfactory to the commissioner. "The loads shall be so enclosed and protected as to prevent the escape of disagreeable odors during transit and the dropping of any portion of the loads into the waters of Boston harbor. The contractor shall at all hours during the day and night prescribed by the commissioner keep at each wharf station at least one scow, so placed and of such capacity that all garbage and refuse brought thereto can easily and immediately be placed thereon."

As a matter of information for the contractor, the specifications contain a table giving approximate weights of garbage and refuse collected within the proposed contract area for the year ending January 31, 1921. This is not assumed to be complete, but is given merely to enable the contractor to judge somewhat of the character and amount of garbage and refuse.

Approximate weights (tons of 2,000 pounds) of garbage and refuse collected within proposed contract area, year ending January 31, 1921, distributed among proposed districts.

District	Estimated Population	Garbage	Ashes and Rubbish	Street Sweepings
1. South Boston	70,400	4,400	25,000	9,700
2. Charlestown	34,600	1,800	......	......
3. North and West Ends	72,200	4,400	51,000	15,300
4. South End & Back Bay	113,700	13,100	73,000	16,700
5. Roxbury and Jamaica Plain	150,400	10,400	56,000	17,100
6. Dorchester	156,400	15,200	......	......
Totals	597,700	49,300	205,000	58,800

FINAL DISPOSAL

If the contractor so desires, the city will furnish him free of cost the land which it owns on Spectacle island, together with wharves, buildings, etc., which will become its property on the expiration of the existing contract.

Methods of Disposal.—Bids may be based on any of the following methods for the final disposal of garbage and refuse, or on combinations of the same:

For Garbage: (*a.*) By incineration. (*b.*) By reduction. (*c.*) By any other method or combination of methods satisfactory to the Commissioner.

For Refuse: (*a.*) By incineration. (*b.*) By filling of marsh lands or flats along the waterfront, or on islands in the harbor, when properly bulkheaded to prevent the escape of rubbish. Clean ashes or any material whose specific gravity is greater than salt water may be disposed of by dumping at sea or by filling. Rubbish may be disposed of by filling, or by salvaging the marketable material and disposing of residue by incineration or for filling.

Incineration of Garbage and Refuse

If incineration of the garbage and refuse be adopted, in whole or in part, the process shall be subject to the following conditions:

(*a.*) *Destructors.*—The Contractor shall erect, maintain and operate destructors of sufficient capacity to handle daily 50 per cent more garbage and refuse than is shown by the average daily collection for the past year. He shall determine the capacity required and submit with his proposal complete detailed specifications for the plants.

(*b.*) *Destructor Capacity.*—The destructor capacity shall be determined upon the basis of a specified mixture of garbage and refuse to be stated by the Contractor in his proposal.

It is to be understood that the specified mixture is simply to establish a basis for making the tests and in no way lessens the Contractor's responsibility to provide a complete plant of sufficient capacity to handle the garbage and refuse as delivered to him under the varying conditions pertaining to the different seasons of the year.

(*c.*) *Tests.*—The guaranteed capacity must be developed, before acceptance, by four tests of at least eight hours each. When making the test the furnaces are to be brought to the normal working conditions before starting, and on ending, the pressure temperatures and furnace conditions are to be brought to the same conditions as when starting. The destructor plant is to be equipped with suitable thermometers and pyrometers for recording the temperatures in the combustion chambers, boiler uptakes, chimney, air supply, etc. Apparatus for analyzing the chimney gases is also to be provided. All expenses of the test shall be borne by the Contractor. Under ordinary running conditions, either when testing or at other times, no auxiliary fuel is to be used in the destructors. Thermometers and pyrometers for recording temperatures and appliances for analyzing the chimney gases shall be provided by the Contractor at any time on request of the Commissioner.

(*d.*) *Ventilation.*—A positive system of ventilation must be provided, so that the forced draft for the destructor furnaces shall be taken from the vicinity of the storage bins and other places needing ventilation and prevent the escape of unpleasant odors. The design of the destructors must provide settling chambers of such size that the velocity of the gases will be adequately reduced and the dust deposited so as not to escape from the chimney. At no time during the continuous operation of the plant shall the minimum temperature in the combustion chamber be less than 1,250 degrees, and the average must be at least 1,600 degrees Fahrenheit.

(*e.*) *Cleaning.*—Ample room must be provided for the cleaning of all flues, dust-settling chambers, boiler tubes, etc., so that the plants may be operated continuously six days each week, one day (Sunday) being allowed for cleaning. The dust chambers, flues, etc., shall be so arranged as to allow of dust being withdrawn after one day's cooling.

Incineration of Rubbish

If the Contractor proposes to submit any portion of the refuse to a sorting process, and so arrange his reclamation plant that the residue from such process is to be incinerated, for such a purpose each incineration unit shall not only be of ample furnace capacity, but shall have a large combustion chamber and liberal size and height of stack to produce the required draft; combustion chamber and stack shall be so proportioned as to climate smoke and disagreeable odors. If the waste heat of such incinerator is utilized for raising steam in attached boilers, a suitable by-pass duct shall be provided so that the boiler may be cut out for repairs.

Reduction

(*a.*) *Location.*—The Contractor may establish a plant for the reduction of garbage in a location satisfactory to the Commissioner and the health authorities having jurisdiction over the proposed location, but such location shall not be upon the mainland within the city limits; or he may utilize the land, wharves, buildings, etc., at Spectacle Island as soon after the completion of the Boston Development and Sanitary Company's contract on July 1, 1922, as said company may require for the removal of its machinery, etc., from the city's property.

(*b.*) *Construction.*—The Contractor shall provide for the operation of his reduction process a fireproof building of brick, stone or concrete, or a combination of the same, of a design satisfactory to the Commissioner and architecturally in harmony with its surroundings. The structure shall be of ample size for the processes and so designed as to admit of extension in all departments.

(*c.*) *Ventilation.*—The buildings shall be so constructed as to prevent, as far as possible, the escape of disagreeable odors. The arrangement of conveyors, tanks, presses, etc., shall be such that after the delivery of the garbage to the conveyor at the wharf the process shall be continuous and the apparatus so inclosed that the material shall be at no time exposed to the outside air. The process, machinery and appliances shall be thoroughly sanitary in effect, and the plant so conducted as not to cause conditions which would be detrimental to the public health or in any way constitute a nuisance.

All gases carrying odors which are produced or result from the operation of the process, machinery or equipment used shall be confined, and, before being discharged into the air, shall be thoroughly deodorized.

All water flowing from the plant shall be inoffensive, free from nuisance or any matter dangerous to the public health.

(*d.*) *Poisonous or Explosive Material.*—If the Contractor shall use in any part of his process any volatile, poisonous or explosive material, such portion of the process shall be conducted in a fireproof apartment entirely separated from the remainder of the plant.

Where material is to be dumped, "suitable precautions shall be taken to protect neighboring premises from flying paper, dust, damage from smoke and from all danger of fire on account of such dumps." No garbage or refuse containing garbage will be permitted to be dumped.

Clean ashes and any material whose specific gravity is greater than salt water can be disposed of by dumping at sea in such locations as the commissioner may designate and under such regulations as may be imposed by the United States harbor authorities. Paper, garbage or other floating material must not be dumped except in cases of extreme emergency, such as fire, flood or extraordinary ice in the water surrounding the city or in the harbor.

If the contractor, from any cause except these just named or for other extraordinary and unavoidable causes, shall fail for more than five successive days to dispose of the garbage and refuse as specified by the contract, the commissioner may cancel the contract or may take possession of the property and operate it for disposing of the garbage and refuse, any excess of cost of such disposal by the city over the contract price being repaid to the city by the contractor; or, if the city does not elect to do either of these, "the contractor shall forfeit and pay the city, as expenses, losses and damages incurred by the city through the contractor failing to do work as aforesaid, a reasonable proportion of the payment for the work for the month in which such failure occurs, as determined by the commissioner."

In performing all of these services the contractor must protect the employees from all avoidable danger of life, limb and health, and contribute to their comfort and well-being. He shall provide facilities necessary for their cleanliness, including an adequate supply of hot and cold running water. For workmen engaged in specially dirty work there shall be facilities for bathing with running hot and cold water and for washing and drying clothing.

Municipal Street Cleaning for Philadelphia

As described in Public Works some weeks ago, the city of Philadelphia is trying out municipal street cleaning in one district, but let contracts for cleaning the streets in the remaining parts of the city. The success of the municipal cleaning has apparently been so pronounced that it has been decided to commence on January 1, next, the municipal cleaning of all the city's streets.

The street cleaning contracts let for this year provided that these contracts could be terminated on October 1 of this year if three months' prior notice was given. The administration wished to give such notice and begin city-wide street cleaning by municipal forces on October 1, but could not obtain the necessary permission and appropriation from council, which, however, has promised to support a full program of municipal work after the contracts expire on December 31.

Operation and Care of Concrete Mixers

Starting and care of boiler and engine. Securing maximum yardage. Keeping mixer clean. Shutting down for the winter.

Instructions for concrete paving mixers that are in general applicable to construction mixers have been issued by the Koehring Company and excerpts from them are here presented for their value in clearly describing important items in the maintenance of all kinds of mixers, their boilers and engines:

PREPARING TO START MIXER

After mixer is assembled, see that all grease and oil cups are full, using a good grade of oil and No. 3 cup grease. Grease cups should be screwed down at least twice a day, to keep all the bearings well lubricated. Be sure to keep all cables lubricated with good cable compound, and all gear teeth well lubricated with a good graphite grease, but DO NOT put grease on rollers or drum runway. The cable clamps should all be gone over to make sure all nuts are tight, as a loose clamp may cause trouble.

Before starting the engine, be sure that all clutches are disengaged; by so doing a bad accident may be avoided.

STARTING AND CARE OF BOILER

After mixer is assembled, a slow fire should be started in the boiler. Do not crowd the fire until steam pressure shows on the gauge, indicating that sufficient steam has been generated to protect the top ends of the tubes; which, in full-length tube boilers are exposed to the hot gases. Hard firing in getting up steam is almost certain to damage the top ends of the tubes. This not only applies to firing the boiler the first time, but holds good for every time a new fire is made.

During the first day's operation, do not keep the water level in the boiler above the middle of the gauge glass, as the water will, undoubtedly, foam on account of the oil and grease on the plates. Blow down the water glass several times a day but never depend on it, as the opening may become choked keeping the water level apparently constant, while the water in the boiler may actually be getting very low. The water cocks are put in the boiler to use, and are the only sure way of ascertaining the water level.

The boiler should be blown off well at the end of the day to remove all grease. After this, sufficient water should be carried in the boiler to show $^3/_4$ of the way up on the gauge glass.

Keep a thin clean fire. This will give you 100% more heat than a thick dirty fire, as the smoke from a thick fire chokes up the tubes, and combustion takes place not in the tubes but in the hood and stack. Clinkers should be removed from the fire box frequently and the ash box should be kept clean. Doing so prolongs the life of the grates and gives a better draft.

If at any time the boiler is to remain out of use for a few days, place a cover over the smoke stack to prevent water rusting out the tubes.

There will probably be injector trouble the first day, due to clogging from scales from new pipes and boiler. In such an event, take injector apart and clean thoroughly.

The boiler tubes should be kept clean, as the soot collected on them is a nonconductor of heat and more fuel is required in order to keep up steam. As often as is necessary, the tubes should be cleaned with a scraper—the frequency will depend entirely upon the fuel used and the carefulness exercised in firing, but they should be cleaned in the morning, at least, before firing up, and during the day they should be blown out every once in a while with steam.

Practically all feed waters contain more or less scale forming substance which precipitate and form incrustations in the water leg, on the flue sheet and around the lower end of the tubes.

Frequently the contractor has to make use of muddy water, and this also collects in the water leg and on the lower flue sheet. This scale and mud, if not removed by frequent cleansing, will become firmly baked on the heating surfaces, retarding the flow of the heat to the water and weakening the iron from stresses due to unequal expansion. An accumulation of scale 1/32 inch thick requires 10 per cent more fuel; 1/16 inch of scale requires 20 per cent more; ⅛ inch of scale requires 30 per cent more; and ¼ inch requires 60 per cent more. By keeping boilers clean, considerable fuel is saved.

Under usual conditions the boiler should be blown off a little every day. It is a good plan, before stopping after a day's run, to pump in more water than required while running. The next morning after firing is started and some ten to thirty pounds pressure has been raised, open the blow-off valve and blow the water down to the proper level. If the water is very muddy, it is a good plan to repeat this at the noon hour. After the boiler has been run for some length of time the boiler should be blown down entirely and thoroughly washed. This should be done at least once a week, and in case of muddy water it could be done to advantage twice a week.

The boiler should not be blown down for washing while under steam pressure. The best time to do it is when the steam pressure has just gone down, but the water is still hot. Open the blow-off valve, let all the water run out, remove the handhole plates and wash out the boiler with a hose. To properly do this it is necessary that the water be under pressure and that a properly shaped nozzle is used. A good nozzle can be made of ⅜ inch or ½ inch pipe having a short bend at the end so as to throw the stream of water at right angles to its length and at high velocity. If ½ inch pipe is used, the opening at the end of the pipe should be drawn down a little on a taper so as to give about a ⅜ inch opening.

The boiler should also be scraped with a scraper consisting of an elliptically shaped piece of iron, which would fit the side of the boiler, and fastened to a rod for handle. A very good cleaner can also be improvised from a heavy wire with a piece of chain secured to the end of it.

If the feed water contains ingredients such as to form a hard scale, impossible to remove by washing, a boiler compound may be used to advantage so as to reduce the scale to a muddy consistency that can be washed out.

The best water obtainable should always be used for the boiler. Where necessary to take it from a road side sump, it is well to make two sumps and use one as a settling basin; or barrels may be filled and water drawn from them after the sediment has settled to the bottom.

STARTING AND CARE OF STEAM ENGINE

After all grease and oil cups and lubricator are filled, see that they are feeding properly. The oil cup on the connecting rod when full should last five hours; the lubricator should be adjusted to feed six drops per minute. The engine being oiled and enough steam in the boiler, see that throttle valve is closed and drain cocks in cylinder and steam chest are open. Open valve in steam line near boiler, and the throttle valve just enough to blow out the water in steam line, steam chest and cylinder. After allowing the steam to pass through a few minutes, turn fly wheel off dead center, open throttle slowly until the engine starts running; then close drain cocks and open throttle valve wide. To avoid blowing out of gaskets, the nuts on the studs, holding cylinder head and steam chest cover in place, should be tested and tightened up, if necessary.

When starting an engine in cold weather, limber it up by letting it run idle a little while before placing any load upon it. When engine is started run it slowly, having all cocks open. Many cylinders are cracked by a sudden change in temperature.

In cold freezing weather, drain all water and oil from the cylinder and lubricator when engine is shut down for the night.

MIXER ON WORK

After mixer has been taken to the work, we suggest putting one or more wheelbarrows full of stone in the drum and running the mixer for half an hour or more, thus scouring it thoroughly and removing all roughness. The revolutions of the drum should be tried out.

It is advisable, upon starting a new mixer, to use one-half the normal crew the first day, in order to allow the operator to become acquainted with his machine and to make minor adjustments of the clutches.

After running the machine a couple of days, remove all slack from cables, as new cables stretch with use. This eliminates the jerks by which they are sometimes broken.

After running a week or so, all nuts should be drawn up, as the new bolts may stretch, leaving the nuts loose.

OPERATING MIXER TO INSURE MAXIMUM YARDAGE

The operator should throw in the hoisting clutch, then when the skip has reached the elevation where it is ready to charge drum, start the water flowing from the measuring tank. After skip has been lowered the operator should close the three-way valve when the water stops flowing. He can tell this by watching the gauge glass on the water tank. When concrete has been mixed the required length of time, has been dumped, and three-fourths of the concrete is out of the drum, the skip should be started up again. By the time it has reached the charging position the drum is empty. Then reverse the tilting discharge chute so that it can aid in mixing the next batch. The operator will have time to run bucket out on the boom and dump it while the batch is being mixed and the skip is being loaded.

KEEP MIXER CLEAN

When contractors finish concreting at noon and in the afternoon, it is advisable to put a few wheelbarrows of stone in the drum and scour it for a few minutes. By doing this a clean drum is assured at all times.

To help instill in the minds of the crew, pride in their work and to secure a maximum of output, the machine should be kept as clean as possible, both on the inside and on the outside. The outside may be kept clean by brushing off the machine each night before shutting down and coating the drum and other parts with oil, which will prevent the cement from sticking. The oil drained from the crank case can be saved and used for this purpose.

In coating the drum and other parts of mixer with oil, care must be taken that no oil gets on the runways of either the drum or the boom.

PREVENT CONCRETE CLOGGING ON BLADES

Cement should never be put in skip first, as it retards the flow of the material when skip is elevated, thereby making it necessary to hold it in that position for a longer time to clean itself. As the cement is last to leave the skip, some of it will stay in the sub-chute until pushed into the drum by the next batch, and some will pack on the inside of the drum head on the charging side, building up a ring around the drum opening. There should always be at least ¼ of the stone or gravel in skip before cement is dumped, as this will aid the flow of material and also prevent the cement hanging in the sub-chute.

It is very important that the water be admitted at the proper time; that is, when the material starts to roll into the drum, so the material and water will enter the drum at the same time to avoid clogging This also increases the mixing efficiency.

SHUTTING DOWN MIXER FOR WINTER

Drain all water from the boiler and steam engine or gasoline engine, and also from piping and water tanks. Pour about one gallon of cylinder oil into the boiler and a quart of oil into the tanks. Fill again with water, then drain. It would be well to add a little whitelead to the cylinder oil just enough to give it a little body.

If mixer is equipped with steam power, remove hood from boiler and clean the tubes out thoroughly with a wire brush and swab carefully with oiled waste or rags. Cover the top of the boiler with canvas and tie it down securely, then coat inside of fire box with heavy oil, and paint or oil the outside of the boiler.

Whether gasoline or steam engine is used, take off cylinder head and coat inside of cylinder with whitelead and oil.

All hard working machinery, especially concrete machinery, must wear; therefore, examine the entire machine carefully and try out all working parts and replace with new parts, those parts, if any, which are worn enough so as not to work properly.

By over-hauling the mixer and replacing all worn parts, when mixer is shut down, no delay will be occasioned by having to make repairs when ready to re-start the mixer in the spring. This should not be neglected, for worn machinery decreases results, and increases delays and consequently labor, and possibly will necessitate extra hours at night for the operator "when the mosquitoes are biting at their best."

After machine has been thoroughly inspected and overhauled, coat all bright parts on mixer with heavy machine oil or, preferably, cylinder oil containing a good heavy body of whitelead. Give balance of mixer a good coat of paint.

Grease all bearings carefully and turn machinery over a few times to insure that the inside of bearings are thoroughly coated. Take off cables and clean thoroughly with kerosene, then pass through a bath of warm lubricant. The following makes a good mixture:

One part freshly slacked lime.
Four parts pine or coal tar.
One-half part powdered graphite.
Heat up and thoroughly mix together.

Clean traction chain thoroughly with kerosene, then give it a good coat of heavy oil.

If possible, house the mixer or cover it with tarpaulin in order to protect it from the weather.

When starting up again after a prolonged shut down, it will, of course, be necessary to clean off all surplus grease and then follow the same procedure as used in starting of a new machine.

ORDERING PARTS

When ordering new parts for a mixer, the contractor should be sure to give the size and number of his machine. This he will find on the nameplate attached to the frame. The part and pattern number he will find in the repair part book which accompanies each mixer.

Enormous Public Construction Due

According to estimates of the Associated General Contractors, normal building construction at present costs would require for manufacturing $306,000,000; residences, $1,195,000,000; business and public works, $396,000,000; public utilities, $492,000,000; miscellaneous building, $303,000,000; railways, $328,000,000; a total of $3,020,000,000 annually.

This is exclusive of highway construction, irrigation, hydro-electric work, river and harbor work.

In addition to the annual normal construction requirements, there is an accumulated construction deficit at present which amounts to almost $15,000,000,000, as follows: Housing, $5,000,000,000, railways, $5,000,000,000; public utilities, $1,900,000,000; highways, $2,100,000,000; miscellaneous construction, $500,000,000.

Eliminating housing and buildings, this leaves a present requirement for almost $14,000,000,000 of construction in the public works field, much of it so urgent that it is difficult to see how it can be long delayed even under the present uncertain conditions that are, however, now steadily improving.

PUBLIC WORKS
Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba.$3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
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FRANK W. SKINNER, Associate Editor

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Mechanical Equipment for Municipal Work

Does mechanical equipment pay in municipal work? It depends on the equipment, the municipality and the work; but in most cases it does, we believe. During the past few years we have described the use of equipment of various kinds by the different departments of a number of cities, and generally satisfactory results were reported. It is unusual, however, to find cost and performance figures as complete as those kept by the Water Department in Baltimore and given in this and next week's issues. Only by a careful and long-time analysis of costs, including overhead, depreciation, repairs, and others, such as lost time of employees due to breakdowns; and of performance, including credit for time saved, can a municipality or contractor decide whether or when the use of a particular kind of equipment is an economy.

Nor should conclusion as to the value of an appliance be reached hurriedly. Certain employees who are prejudiced against an appliance may find it easy to make a poor showing for it; or such a showing may be due to lack of skill in the employee or of his adaptability to a new device or method. Again, the conditions of use may be unfavorable to the appliance; if it be a trench digger, for instance, many boulders or existing house connections in the street it is tried out on may so delay the work or increase the difficulty and cost as to give an unfavorable impression as to the value of the appliance, although if used on another street or after experience had shown how to meet the difficulties, the judgment concerning its value might be entirely different.

On the other hand, in estimating cost of work done by these appliances there is danger that not sufficient allowance may be made for first cost, short life, repairs, loss of time of entire gang should there be a breakdown, number of days per year it can be worked, etc.

All of these points were considered in Baltimore, and we recommend a study of the article referred to, not so much to find out whether the particular devices named were successful and economical in this case as to learn how to arrive at reliable decisions with reference to the use of any appliance in the locality in which the reader is especially interested.

Municipal Bonds

The total sale of state and municipal bonds in June was considerably greater than that of any previous June, having been $116,965,650. Also the sale for the first six months of this year was greater than for any previous similar period, having been more than $499,000,000, according to figures published by the "Daily Bond Buyer," of New York. Last year the sale for the first six months was a little under $349,000,000, which was greater than for any previous six-month period. The most important sale during the first six months of this year was one of $31,800,000 of New York state one to fifty-year serial 5 per cent highway, canal and forest preservation bonds. The next largest was New Jersey's $17,000,000 soldiers' bonus and highway bonds. Other large sales were the municipal bonds of Chicago, Cincinnati, Flint and Pittsburgh and the states of Oregon and Pennsylvania.

Utilizing of Spare Head by Water Works

Several instances exist of unnecessary and even unused head of water in water supply systems going to waste—perhaps more instances than are realized. The utilization of such head at two of the reservoirs of the Boston Metropolitan water system was described in last week's issue and showed profits of $30,000 to $50,000 a year, after making allowance for depreciation and overhead, on an investment of about $224,000, or about 15 to 20 per cent.

Some of the Pacific Coast cities have made the creation of hydro-electric power a very important part of their recent water projects, but eastern cities, as a rule, have given little thought to this, and it is quite possible that there are a number of gravity supplies that would furnish power from their superfluous heads at little cost. Where an impounding reservoir is more than 250 or 300 feet above the city it will generally be possible to utilize any head in excess of this. Especially favorable is the condition where water from an impounding reservoir flows into a distributing reservoir at a lower level, for here not only can the difference between the elevations of the two be utilized, but the flow can be kept continuous at a uniform rate for any desired number of hours a day, which is not possible when the flow is utilized on its way directly to the distribution system.

Where present construction is not such as to favor a hydroelectric plant, it may still be worth while, in some cases, to establish such a plant by supplementary construction, as by building a secondary dam higher up as a power dam, which will offer the additional advantage of affording more storage of water and regulation of flood flow.

Under modern conditions electric power can almost always find a market, by attracting new industry if there is no existing demand for it, or low-cost power can replace existing power created by steam. But a careful estimate should, of course, be made of the cost of the proposed installation, and revenue assured sufficient to cover all charges, including interest, depreciation and obsolescence.

John F. Wallace

John F. Wallace, past president of the American Society of Civil Engineers, died in Washington, D. C., July 3. Mr. Wallace, who had a high reputation as an executive engineer, was formerly president of the Illinois Central Railroad, and resigned his railroad position to become, for a short time, chief engineer of the Panama Canal. Subsequently he became chairman of the Chicago Railway Tunnel Commission and chairman of the Board of Westinghouse, Church, Kerr & Co., New York.

James Owen

James Owen, a past director and for 52 years a member of the American Society of Civil Engineers, was buried from his residence in Montclair, N. J., May 7. Mr. Owen was one of the last survivors of a prominent group of noted members of the American Society of Civil Engineers, to the interests of which he had always been devoted.

For several years Mr. Owen was engineer of Essex county, N. J. He designed and constructed several sewer systems, including that of his home town, Montclair, and of the Overbrook Asylum. He was eminent in the early development of better roads and was an important factor in making New Jersey the pioneer in the improvement and state control of highways at a time when the most advanced practice, outside of cities and towns, was the construction of high-class Telford macadam pavements.

Until recently Mr. Owen kept up his private practice and maintained offices in Newark, although his winters were generally spent in the south.

American Society For Testing Materials

At the annual meeting of the society, June 21-24, at Asbury Park, N. J., the regular reports that were of special import to public works interests were those of standing committees on Concrete and Concrete Aggregate and on Roads and Paving Materials. Committee C-9 presented tentative standards for making compression tests of concrete; tests of organic impurities in sand for concrete; tests for sieve analysis of aggregate for concrete; methods for securing specimens of hardened concrete from the structure; and specifications for concrete aggregate. It also recommended the adoption as standards of the tentative methods of tests for the unit weight of aggregate for cement concrete and the method for making and storing specimens of concrete in the field.

The lines of research on which this committee are now employed include the Laws of Mechanical Mixes of Cement and Aggregate, Researches on Impurities of Aggregate, Investigation of Coarse Aggregate, the Best Type of Specimen for Mortar Tests, Distribution of Aggregate Materials Throughout the Country, Concrete Specifications, and Testing of Field Concrete After It Is in Place.

Committee D-4, on Road and Paving Materials, recommends slight modifications in existing standards and recommends the standardization of the tentative tests already put out for quantity of clay and silt in gravel highway construction, quantity of clay and silt in sand for highway construction, recommends the continuance for another year of the tentative specifications for block pavement, for workability of concrete, for concrete pavements, for commercial sizes of broken stone and broken slag for highway construction, for commercial sizes of sand and gravel for highway construction, for broken slag for waterbound base, for shovel run or crusher run broken slag for waterbound bases, for natural or artificial sand-clay mixtures for highway surfacing, tests for specific gravity of road oils, road tars, asphalt cement and soft tar pitches, specific gravity of asphalt and tar pitches, sufficiently solid to be handled in fragments, test for quantities of clay in sand-clay, for top soil and semi-gravel for highway construction, and methods for sampling of stone, slag, gravel, sand and stone block for use as highway materials, including some material survey methods.

They also issued a tentative method for test of ductility of bituminous materials, a tentative method for the determination of water in bituminous materials and tentative specifications for calcium chloride for dust prevention, for asphalt cement, for tar for surface treatment, for cold applications, for tar cement for use in cold repair work (cut back product), for tar for surface treatment, hot applications, for tar cement, for coal tar pitch, for block filler.

The report of the executive committee showed a net increase in membership during the past year of 154, with a present total membership of 2,900. During the year new committees have been organized on Screen Wire Cloth and on Nomenclature and Definitions.

The publication has been commenced of a bulletin particularly designed to afford the committees an opportunity to secure greater publicity of their work as it develops between annual meetings. During 1920 the committees and subcommittees held a total of 90 meetings, the treasurer's report for 1920 showed assets and liabilities of $27,594.52, with total receipts during the year of $57,777.88 and cash on hand of $265.05.

During the year the society has continued to take an active part in the work of the American Engineering Standard Committee and five of its tentative standards have been approved by the latter. The society is co-operating with the American Society of Mechanical Engineers' Boiler Code Committee and with the Government and the American Petroleum Institute, with the Society of Automobile Engineers, the American Society for Steel Treating and with the division of engineering of the National Research Council. It has participated in the work of the joint committee on the Investigation of Phosphorous and Sulphur in Steel, on Standard Specifications for Concrete and Reinforced Concrete, on Concrete Culvert Pipe and on Standard Pattern Practice.

Concrete Arch Bridges

By B. H. Davis, C.E.*

The development of enduring, safe and artistic highway arch spans has been accomplished within the present generation, coincident with the quantity production of Portland cement, and provides for a great variety of structures of unlimited capacity, built by simple methods, with local materials and labor, and with notable ultimate economy.

Beginning 4,000 years ago with the three-voussoir five-foot span arch found in a Theban tomb, which may be considered to represent the first elements of arch construction, arch bridges developed through many centuries.

The bridges of the Roman era with stone spans of less than one hundred feet maximum have proved enduring even to the present day, not only for military and civil purposes, but for the domestic welfare of towns and cities to which they brought supplies of mountain water in their famous aqueducts such as Claudia, Segovia and Pont de Guard.

After the fall of the Roman Empire and the decline of the Roman builders, bridge construction was at a standstill for many centuries and very few important bridges were built except by the Moors in Spain.

Some crude attempts to extend stone arch bridge construction by the use of wooden arches were made during the dark ages (500 to 1100 A. D.), of which we have imperfect records of a few containing spans up to 100 feet in length.

The civilization which had been built up by the Romans in Southern Europe, in France and Britain went into decay and it took nearly 500 years for the civilized world to recover. The races which became the governing powers had but little use for the artistic and beautiful and the conveniences of the civilization developed by the Romans.

The finely constructed bridges and aqueducts ceased to be maintained and these magnificent structures became ruins. Whenever bridges were constructed they were poorly and cheaply made, very narrow, seldom more than 20 feet in width, and in every way inferior to those of the Romans.

MODERN PROGRESS

No particularly noteworthy progress was made in bridge building from the time of the Romans until about 125 years ago, when a number of cast iron arch spans were built in England.

A further impetus to bridge building was given by the early settlers in America where the enormous quantities of splendid timber encouraged the use of framed structures, the design of bridge trusses was practically inaugurated, and spans of wood alone were built up to 200 feet in length, including some famous old arch trusses. From wood, combined with wrought iron tie rods, the Howe trusses were developed and further progress carried those spans to a limit of 200 to 300 feet.

The next step was the introduction of cast iron for details and minor portions of these bridges, followed soon by replacement of the wooden members with cast iron members, both in the trusses and in the elements of the arches.

A little later, almost within the memory of the junior members of this society, a considerable advance was attained by the use of riveted wrought iron members, thus making the bridge trusses wholly of wrought iron and extending their spans to a maximum of 550 feet, which about 40 years ago was considered a great triumph.

Eventually the replacement of wrought iron by steel has enabled the spans of bridge trusses to be increased to the maximum of 1,800 feet, attained three years ago by the famous and ill-fated Quebec Bridge, almost 100 feet in excess of the world-renowned Firth of Forth bridge in Scotland.

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* Address delivered to Rochester Engineers' Association, May 13, by the designer of the 450-foot span concrete arch of the Ridge Road Highway bridge now under construction across the Genesee River gorge at Rochester, N. Y. Numerous stereopticon slides were shown, illustrating ancient and modern arch bridges and the methods of constructing the latter.

While trussed spans attained this remarkable development, masonry structural development stood practically still for centuries, the limits considered possible for cut stone arches with few exceptions being but little greater than they were in the time of Christ.

THE RAPID DEVELOPMENT OF CONCRETE ARCHES

The Romans developed remarkable success with their famous concrete, but it was carried no farther until within the last two generations when the scientific manufacture of hydraulic cement became more general and larger quantities of this material were available.

American engineers were quick to see the tremendous possibilities of this new material which permitted the construction of what is practically artificial stone in unlimited quantities of any desired dimensions.

Its application to arch bridges was rapid and successes were brilliant. Their spans thirty years ago probably nowhere exceeded 100 feet and very seldom exceeded 40 feet, being considerably below the upper limits of masonry arches.

Such engineers as Edwin Thatcher, Jean Monier and Prof. Meland devoted themselves to the mathematical analysis and mechanical features of concrete arch construction and devised several types of structures, such as the hinged, hingeless, barrel vault and ribbed types of arches with various kinds of spandrel treatment and floor construction which were adaptable to most highway, and even to railway, requirements.

With the increasing facility in construction methods, through improved plant and appliances for their construction, the cost of arch bridges decreased and the available dimensions increased until we now have existing spans 328 feet in length with others under construction of 400 feet clear and still others contemplated and already designed having spans 425 to 703 feet clear opening, and it is of these examples of the bridge builders' art that I wish to present to you some of the essential features and describe the methods involved in their design and construction.

GOVERNING FACTORS OF DESIGN

The capacity of a bridge must necessarily be determined by the local requirements, as well as by the available resources, and the latter should, if possible, conform to the true economies of the problem.

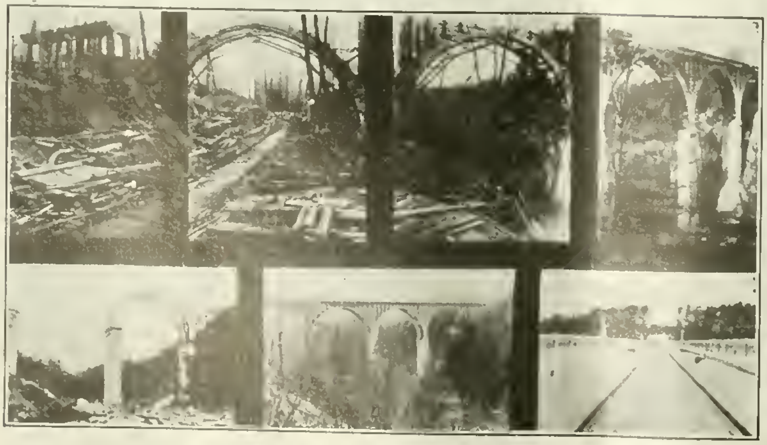
The capitalized valuation of the structure must be compared with its ultimate cost. When this is done it will be found that although other types of bridges may sometimes be erected for a smaller initial cost, the final cost, after a period of 20 years, to which we may add 50 to 100 years which the concrete bridge may be safely expected to endure, will be far less for the concrete structure since its maintenance under proper conditions may be almost disregarded.

IMPORTANT ADVANTAGES OF CONCRETE ARCH SPANS

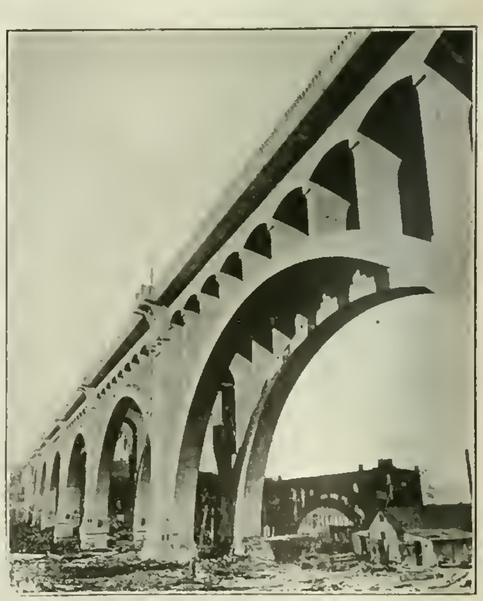
One great advantage of the concrete bridge is that it is almost impossible to make it too light, in other words, the minimum of material necessary for the mechanical operations of its construction afford a margin of strength considerably greater than is necessary to carry the dead load of the structure and this margin of strength is generally abundant for any live load that may be imposed.

With strength the fundamental principle of the design, which always compels the designer to give recognition to live load that can under no practical conditions exceed the capacity of the bridge, a concrete bridge may be safely expected to carry any increase whatever that may occur in traffic conditions, no matter how unexpected and enormous they may prove to be.

Concrete also, through its plastic nature, lends itself more than any other material to architectural and artistic treatment and permits arch structures to combine to the utmost strength and symmetry that lend dignity and elegance, therefore making them with very little if any extra expense quite ornamental, and often monumental in their character.



ERECTION, ON STEEL TRUSS CENTERS, OF VIADUCT AT AKRON, O.



VIADUCT AT ALLENTOWN, PA.

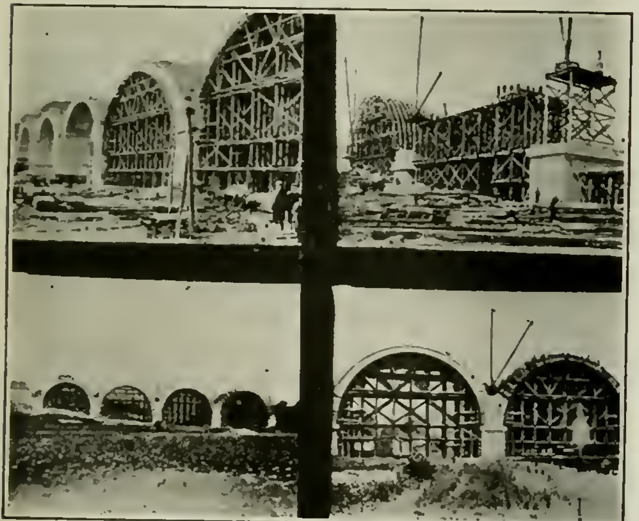
Furthermore, the construction of a concrete arch is one of the most independent of all engineering operations, since it generally is built almost wholly of local materials, easily procured at any time by simple methods, depending to a very small degree on imported materials, and as a rule it can be erected under competent supervision by local labor, requiring few trained or skilled workmen.

ESSENTIAL REQUIREMENTS

In general, it suffices that a concrete arch bridge should be carefully planned to meet the best requirements of the situation, should be designed by an experienced engineer and should be erected under his strict and constant supervision. These requirements having been met, it may be safely assumed that a concrete arch will be a thing of beauty and a joy forever.

The mathematical features of analysis and design of a concrete arch do not need to be enlarged upon before this audience. It is a matter of choice between the different types of arch rings and revisements, all of which can be analyzed and proportioned by the usual graphical and analytical methods.

The construction of an arch bridge, however, is a more difficult matter, which can properly be appreciated or criticized by comparatively few engineers, who have had an opportunity to witness or participate in their construction so that experience really must be the principal guide.



ERECTION, ON WOODEN FALSEWORK, OF PAULING KILL RAILROAD BRIDGE

It will suffice here to show you a few views of arch bridge work of various sorts under construction, and to remind you that the principal anxiety of a bridge builder is in regard to the foundation conditions, the height of the structure, the depth and velocity of the stream at various stages, the danger from ice and drift, the possibility of interruption to navigation, the provision for traffic and the support of the wet or plastic concrete until it attains a strength sufficient to form a safely self-supporting arch.

The sub-structure is a vital part of the arch bridge and must be built beyond all possibility of settlement during construction. The piers and abutments may, under favorable conditions, be built on the surface of the rock or in any satisfactory excavations, benches or stops cut in same. At other times they must be built in cofferdams and even by pneumatic caisson methods.

SEGOVIA AQUEDUCT, SPAIN

CONSTRUCTION OF SUPERSTRUCTURE

After the piers and abutments are provided, some sort of temporary support between them is necessary to carry the enormous loads of wet concrete. This is ordinarily provided by the familiar trestle or wooden falsework, consisting of transverse bents, supported on sills or piles, or by fan-shape braces radiating from the pier footings for short spans.

For longer arch spans of 100 feet or more falsework trusses temporarily spanning from pier to pier are usually employed and moved from span to span as the work progresses. These trusses for shorter spans may be made of timber, but generally, especially for multiple service, they are made of riveted steel members, and are practically equivalent to steel bridges themselves, being used over and over again and forming a part of the contractor's permanent plant.

These support the curved platform or lagging on which the arch or arch ribs are concreted in simple forms similar to those with which you are familiar for any mass concrete work. With their completion, the falsework, of whatever nature it may be, is lowered and released from the weight of the concrete and moved away, the spandrell construction and the floor system are subsequently built by ordinary concrete methods and supported during construction by the arch itself.

It remains for the contractor to devise economical, efficient and rapid methods of mixing, handling and placing the concrete and reinforcing materials. The former is usually attained by providing elevated storage bins for his aggregate and powerful engine driven machines for mixing.

The concrete in batches of one-half yard to one yard or even more is discharged from the mixers into buckets or dump cars and is transported, lifted or spouted to the forms for the arch ribs or super-structure by derricks, by cableways, by dump cars on elevated or depressed service tracks or by towers and spouting systems.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Drive Wooden Piles–III[*]

Handling piles, starting and driving, cutting off, pulling with tackles, levers, jacks and hammers, driving with water jets, screws and explosives., Rapidity of driving.

As driven, each pile is generally snaked to the driver by the pile line which is attached to it by a chain fastened to the point and pulls it a maximum of 400 or 500 feet to the machine where the hitch is shifted to the butt and the pile hoisted into vertical position and placed between the ways. It is usually held back against the rear of the ways by a line that is eased off as the pile penetrates, and is adjusted a little and sprung from side to side by handspikes levered against the ways as required.

The location of each pile is determined from centers given by the engineers, and is marked by a stake driven by the contractor. Care is taken to spot the pile within 1 or 2 inches of the exact center, and it is driven as accurately as possible, but it is subject to possible displacement by obstructions or careless driving. Some displacement may be corrected by careful driving, but if it is greater than 12 inches the pile is usually pulled and redriven, or another pile is driven to replace it. For timber trestle work and where piles are capped with timber sills or grillages, greater accuracy of position is required than where, as is frequently the case, their tops are embedded in a concrete footing.

PRACTICAL CONSIDERATIONS

An experienced driver will regulate his blows so as to produce the maximum penetration and the least danger of injury to the pile, he will keep his pile plumb, on center, and select it for the minimum waste. When a pile encounters subterranean obstructions they can generally be recognized by the rebound of the hammer and by the sound of the blow, which will also tell the experienced driver when the end is brooming. A sudden acceleration of the penetration or of the transverse displacement or deviation from the vertical after hard driving is likely to indicate a broken pile.

When a large number of piles are driven on very close centers, especially in sandy soil, it is well to commence driving at the center of the group and work outwards, thus making the penetration easier and reducing the tendency of the new piles to crowd out the others, sometimes raising them a number of inches and necessitating redriving.

When very long piles are required they may be secured by splicing two shorter piles. Formerly this was done by bolting wooden fish plates on both sides of a butt joint, as was done for the 120-foot piles for the falsework of the intermediate 500-foot spans of the Poughkeepsie bridge that were driven through about 60 feet of water into deep, soft mud. The best present practice is to secure a short section of extra heavy steel pipe of the required diameter and fit it carefully to the adjacent ends of both piles that are cut square so as to take bearing on each other in the center of the sleeve enclosing them.

DRIVING EXPEDIENTS

In starting a pile of nearly the full length of the ways, there is sometimes so little clearance for the hammer on the head of the pile that the first strokes must be very short. If these are too short the difficulty is sometimes remedied by spudding, that is, a shorter pile is placed in the leads, driven a few feet, withdrawn, and the permanent pile promptly placed in the hole thus prepared where it settles or is easily driven far enough to allow a satisfactory hammer blow to be delivered to it.

In hard loam or clay it is sometimes very advantageous to soak the surface of the ground thoroughly by a hose stream directed alongside the pile point when or before driving is commenced. This will often quickly soften the ground enough for the pile to penetrate a few feet very easily and be securely held in position under the first light blows that become rapidly more effective.

When piles are to be driven below the bottom of the tower sills, and often in driving them below the surface of the water, a follower is used, which consists simply of a short length of a heavy pile, and usually is connected to the top of the pile, generally by a detachable sleeve or socket or sometimes with a dowel, and has the upper end arranged to engage a sliding block in the guides and receive the blows from either steam or drop-hammer.

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[*] Part I. General conditions and requirements, number, size, penetration, refusal, capacity, calculation, tests, pointing, cutting, banding, hand and horsepower driving was published July 2.

Part II. Drophammers, towers, cantilever and turntable drivers, penetration, steam hammers and double-acting hammers was published July 9.

PULLING

When piles are pulled soon after being driven, it is generally accomplished by a six-part pulling tackle that can exert a strain of perhaps from 30 to 50 tons, according to the efficiency of the hoisting engine. If the pile has long been driven it is customary to strike it one or two blows with the hammer to dislodge it before pulling. It is also sometimes helpful to clamp or cramp bearings on the pile and operate jacks against them which will greatly facilitate the pulling in very stubborn cases. After the pile starts to rise and the adhesion of the ground is broken it is pulled much more easily than at first and the jacks may be replaced by tackles.

When there is plenty of space between piles and they do not have to be fitted to timber caps it is quicker and more economical to chop off the tops to the cut-off line. In other cases they are usually cut off with accuracy by two men and a cross-cut saw, the latter being lined up by a pair of carefully leveled horizontal battens temporarily nailed to opposite sides of the pile at cut-off line. About 40 piles in 8 hours would be a fair record for cutting off with two men and a saw. If accuracy is not required the tops are often chopped off with axes and if the pile tops are cut off under water it is generally done with a belt-driven circular saw mounted on a vertical shaft and arranged for adjustment at any elevation.

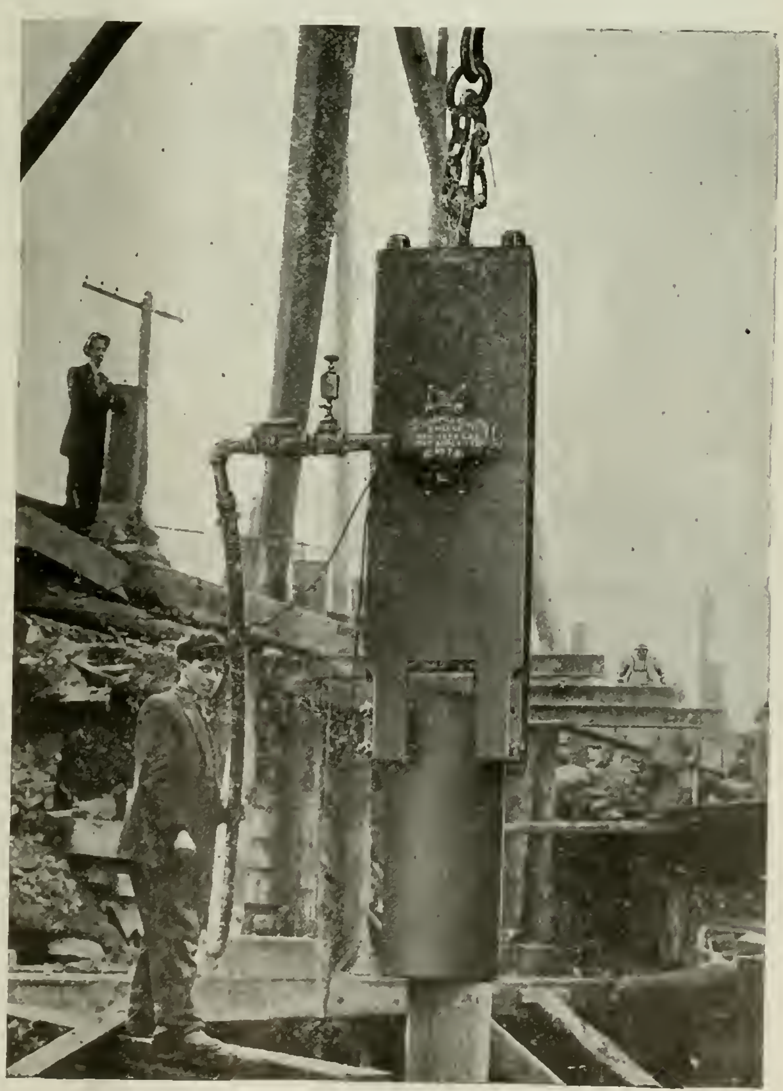
A great advantage of the double-acting hammer is that by reversing its action it can be made to pull piles with the same facility and about the same speed with which it drives them. This is effected by inverting the hammer and attaching it with a strong connection to the top of the driven pipe. If the hammer is maintained in a vertical position and a constant lifting tension is applied to it, its operation will start the pile moving upwards at about the same speed at which it moved downwards; at the completion of the driving and after the motion is well established the hammer may be removed and the pile withdrawn by the use of an ordinary tackle.

This method of pulling has become standard and has been very satisfactorily used on a large amount of important work where piles have been pulled that it was estimated would have required 100 tons tension of a powerful tackle if the hammer had not been operated on them. The pulling is prompt and successful in many cases where ordinary tension or even the operation of jacks would be exceedingly slow or inefficient.

The harness with which the hammer is attached to the pile must be very strong and well adjusted to endure the severe duty. It may be made of welded steel bars or it may consist of a lashing of steel wire ropes, which is much cheaper and simpler than the welded frame and will suffice for ordinary work, although it cannot be easily made as strong as the welded frame.

For driving piles through sand, gravel and some other materials, great advantage is often derived by the supplementary use of a hydraulic jet carried down with the pile or in advance of it to soften the ground, scour out a hole, and often to undermine large stones and cause them to sink through the soft material in advance of the pile. Water at from 1 to 200 pounds pressure or more is delivered through a flexible hose connection to a steel pipe detachably connected to the pile and is discharged through a nozzle at the lower end of the pile. The nozzle may be circular up to ¾ inch diameter or flattened to a width of about 2¼ inches, or shaped to give the water a whirling motion, which is considered advantageous.

In sand or in other loose material, the hydraulic



McKINNON-TERRY DOUBLE ACTING STEAM HAMMER WITH ATTACHED SLEEVE CAP, DRIVING PILE WITHOUT LEADS.

jet is sometimes so efficient that it alone suffices to sink the pile to a considerable depth, and may, under certain circumstances, be entirely sufficient for the operation, although it is generally accelerated and improved by starting the pile with a few light blows with a hammer, repeated at the end of the operation to set it firmly in position. If a hammer is not available the pile may sometimes be forced down by loading it, and jetting, or by applying pressure through a long lever.

In very soft material like silt or thin mud, a pile may be driven to considerable penetration by loading or leverage alone without the jets, but in any case the penetration will be accelerated by the addition of some impact either from a light drop hammer or even from a very heavy hand sledge, maul or battering ram. Small groups of foundation piles for highway bridges in a New England state were driven by hand with a short, heavy green log used for a hammer.

SCREWED PILES

Steel or iron, solid or hollow piles are sometimes screwed down in soft ground when they are provided with a sort of screw point having wide spiral flanges with a long pitch and are equipped with a hand or power device for revolving them around their vertical axis. The same sort of screw point might be attached if necessary to the bottom of a wooden pile if the conditions and requirements were favorable, particularly if it was desirable to resist upward pull on the pile in service or to secure extra bearing in very soft material.

The screw thread or flange can be made of cast iron or bent steel plates and provided with a socket to fit the end of the pile. The pile can be turned by capstan bars applied to the head, by tension on a rope around the pile, or by gear and motor attached to the pile. This method is not likely to be ordinarily desirable, but may possibly be used in case of special requirement or emergency.

DRIVING BY EXPLOSIVES

Piles have been driven by the explosion method, in which a small chamber is provided in the top of the pile and small charges of gunpowder are fired in it by the action of a light hammer falling on the pile. About 4 ounces of gunpowder is sufficient to drive a pile 20 feet into the mud and about 21 ounces will drive it the same distance in gravel. Piles have also been driven to moderate depths by small charges of dynamite exploded on iron plates laid on the tops of the piles.

When piles are driven with single or double-acting steam hammers or with drop hammers operated by steam power, the number of piles driven per day depends on the length of pile, the character of the soil, the efficiency of the hammer and of the crew and very greatly on the location and arrangement of the piles.

Under the most favorable conditions, where the ground is soft and free from obstructions and the piles are spaced close together in long continuous rows from 50 to 100 piles may be driven to a penetration of 30 or 40 feet in 10 hours by a crew of ten men, operating a drop hammer and 50 or 100 per cent more may be driven under the same conditions with a steam hammer.

Ordinarily a large part of the time is required for shifting the machine and for placing the piles. When this is reduced to the minimum and all the delays are eliminated, very rapid driving and consequently low costs may be secured. All other things being equal, the driving is more efficient, the results are better, and the working value of the pile is greater for piles driven rapidly than for those driven slowly. By careful watching an experienced driver can interpret the behavior of the pile and the hammer so as to form a pretty fair opinion of subterranean condition and the condition of the pile itself. On important work it is desirable that a careful log should be kept of the driving of occasional piles, enough, at least, to indicate any material changes encountered.

Cement Manufacturers' Combine Sued

Under orders from Attorney-General Daugherty suit was brought June 30 in the United States District Court, New York City, for an injunction against and dissolution of the Cement Manufacturers' Protective Association and its officers and members.

The officers of the association are E. P. Alker, President; C. Raymond Hulbert, secretary; and Marion S. Ackerman, treasurer.

The Attorney-General said this association produced approximately 90 per cent of the total Portland cement used in the northeastern part of the United States.

The proceedings will supplement criminal action instituted last March, and will not stop its prosecution. The court may order an effective dissolution of the combination and enjoin its members from reconstituting their association, thereby affording the public substantial and practical relief without regard to results in the criminal case.

Members of the association named in the complaint are the Atlas Portland Cement Company, Allentown Portland Cement Company, Alpha Portland Cement Company, Bath Portland Cement Company, Coplay Manufacturing Company, Dexter Portland Cement Company, Edison Portland Cement Company, Giant Portland Cement Company, Glens Falls Portland Cement Company, Hercules Cement Corporation, Knickerbocker Portland Cement Company, Lawrence Company, Lehigh Portland Cement Company, Nazareth Cement Company, Penn-Allen Cement Company, Pennsylvania Cement Company, Phoenix Portland Cement Company, Securities Cement and Lime Company and the Vulcanite Portland Cement Company.

The Cement Manufacturers' Protective Association is organized for the exchange between members of comparative statistical data which enables each to know what his competitors are doing. For some time past the investigation of every complaint of an alleged violation of the Sherman anti-trust act has invariably led to the doors of one of these associations.

Recent Legal Decisions

ADJUDICATED BALANCE DUE ROAD CONTRACTOR HELD ASSIGNABLE

The Mississippi Supreme Court holds, McGraw v. Board of Supervisors of Winston County, 87 So. 896, that when a contractor has constructed public roads in a county or subdivision thereof, and such roads have been completed and accepted, and the balance due such contractor for the construction of the roads has been finally adjudicated by the board of supervisors, and there only remains the duty of ordering the issuance of a warrant for this balance, the contractor may assign this balance due to him, and the assignee thereof may maintain mandamus to compel the board of supervisors to issue to him a warrant for the balance so assigned.

MISSTATEMENT IN ORDINANCE OF PRO RATA COST OF PAVING IMPROVEMENT WILL NOT INVALIDATE CONTRACT

The Ohio Supreme Court holds, City of Newark v. Fromholtz, 130 N. E. 561, that a mistake in publishing an "ordinance to proceed" with a paving improvement, where such mistake is confined to misstating the pro rata proportion or percentage of the cost of the improvement to be assessed against abutting property, is not a defect fatal to the legality of the publication of the ordinance and a contract authorized and directed to be entered into by the terms of such ordinance will not be held to be invalid for that reason.

PROPER CHARGES IN MATERIALMAN'S ACTION ON ROAD CONTRACTOR'S BOND

In a materialman's action against a surety on a road contractor's bond conditioned for payment of supplies or provisions furnished for the prosecution of the work, the Oregon Supreme Court holds, Clatsop County v. Feldschan, 196 Pac. 379, that an amount due for horse feed furnished was a proper charge against the surety, and also the amount due for feeding the contractor's employees, but not sums for tobacco, cigars and cigarettes furnished the men, nor expenses for procuring knives, forks and dishes.

CITY NOT LIABLE FOR DEFECTIVE FOOTBRIDGE BUILT BY RESIDENTS ON ITS PROPERTY

Before a city can be held liable in an action for personal injuries because of a defective footbridge, both pleading and proof must show an obligation to the plaintiff on the part of the city which has been violated. And where it appears the footbridge was constructed by neighboring residents on park and boulevard property for neighborhood convenience, but not constituting a part of the city's public ways, it was held that the city was not liable, it not having accepted the bridge, nor by any act invited the public to use it as part of its public highway system. Dering v. City of Cleveland, Ohio, Supreme Court, 130 N. E. 504.

ORDINANCE AS TO TEMPORARY OBSTRUCTIONS IN STREETS UPHELD

The Ohio Supreme Court, City of Xenia v. Schmidt, 130 N. E. 24, upholds the constitutionality of an ordinance of the city of Xenia making it unlawful to place on the streets or sidewalks of the city any wood, coal, box, merchandise, etc., or any other material or obstruction whatsoever, unless for such reasonable time as may be necessary to load or unload same from any building, and unless the public passage shall not be blocked; the provisions not to apply to permanent structures. It is held that a classification of street obstructions into temporary and permanent, and providing that the ordinance shall operate only upon temporary obstructions, is a real and reasonable classification, and does not violate any provision of the state or the federal constitution.

DIRECTIONS TO ROAD CONTRACTOR NEED NOT BE ENTERED ON MINUTES WHERE POWER OF SUPERVISION RESERVED

Where there is a valid contract in existence between a board of county commissioners and a contractor for the construction by the latter of a public road, which contract reserves to the commissioners and their engineer the direction, supervision and control of the work in a manner specifically detailed in the contract itself, the Ohio Supreme Court holds, Putnam v. Board of Commissioners of Paulding County, 130 N. E. 165, that directions given by the board or its engineer, under such reserved power, are not required to be entered on the minutes, or to be in writing, in the absence of express provisions in the statute or the contract to that effect.

CONTROL OF COUNTY ROADS BROUGHT WITHIN CITY LIMITS

Under the Texas statutes an incorporated city or town has the exclusive control of all the streets and highways within the limits of the corporation, and when such corporation in its creation or by subsequent extension embraces within its limits a portion of a public county road, such road becomes thereafter a street of the city and is no longer subject to the control of the county, and all the rights of the county in such highway pass to the city. Feris v. Bassett, Texas Court of Civil Appeals, 227 S. W. 233.

ASSESSMENTS FOR SEWER IMPROVEMENTS—ENHANCEMENT OF VALUE

The Illinois Supreme Court holds, in a proceeding by a village for the establishment of a sewer improvement, Village of Bradley v. New York Central R. Co., 129 N. E. 744, that the fact that certain property affected by the improvement was at the time provided with sufficient sewer facilities for its present use would not relieve it from assessment if the effect of the improvement would be to enhance its value for the use for which it was best adapted.

NEWS OF THE SOCIETIES

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference. Hotel La Salle, Chicago, Ill.

Aug. 23-25—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS Annual meeting. Detroit, Mich. Secretary, Emmet P. Griffin, Superintendent of Park, East St. Louis, Ill.

Aug. 30-Sept. 1—MICHIGAN STATE GOOD ROADS ASSOCIATION. Annual meeting. Flint, Mich.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

AMERICAN ASSOCIATION OF ENGINEERS

The board of directors met in Chicago June 24-25. Out of 16 directors 14 were in attendance.

The country was divided into 12 districts. Provision was made for continuing the Washington office for the balance of the year. A committee of 15 was appointed to draft a plan for financing the employment service, including a consideration of requiring contributions from recipients of the service as provided in the resolution adopted by the seventh annual convention in Buffalo in May.

A committee of five was appointed to amplify the statements and objects of the association. A very forward looking step was taken to further one of the principal objects of the association "to raise the standard of ethics of the engineering profession" by an invitation issued in the name of the board of directors to all engineers, whether members of of A. A. E. or not, to submit questions of ethics to the board for reference to the practice committee. After a sufficient number of cases, both hypothetical and actual, have been passed upon by the practice committee and approved by the board, they will be published in pamphlet form for general circulation.

An administrative board was appointed to supervise and direct the policy of the professional engineer. The board authorized the committee on services and fees of practicing engineers, of which Langdon Pearse, of Chicago, was made chairman, to hold a national conference of practicing engineers at such time and place as the committee may decide.

A committee of three consisting of President Garman, Secretary Drayer and First Vice-President Johnson was appointed to meet with a committee of three appointed by the executive board of the American Engineering Council to study relations and cooperation.

ENGINEERING SOCIETY OF AKRON

The Engineering Society of Akron has elected the following officers: President, J. H. Vance; vice-president, L. G. Tighe; directors, R. R. Metheany and H. G. McGee; and secretary-treasurer, H. G. McGee.

PORTLAND POST, SOCIETY OF AMERICAN MILITARY ENGINEERS

At its annual meeting on June 13, the Portland (Ore.) post of the Society of American Military Engineers elected the following officers: President, F. S. Cook; vice-president, P. Hetherton; secretary, E. B. Thompson; treasurer, S. C. Schubert; and assistant treasurer, A. D. Montieth.

INDUSTRIAL NOTES

The San Francisco office of the Pawling & Harnischfeger Co., of Milwaukee, has been moved from the Monadnock building to 32 Beale street, where the company maintains a complete service station, warehouse and display room for crane and hoists, machine tools and excavating machinery.

Mr. R. M. Taylor, district manager for the Pacific Coast, has his headquarters now at the Beale street address.

Prof. Charles A. Ellis, of the University of Illinois, has resigned to become vice-president of the Strauss Bascule Bridge Co., of Chicago.

The National Engineering Company has been organized by I. Muschel, formerly inspector of construction, Navy stations, Pensacola, Fla., and Norfolk, Va., to specialize in the design, erection and construction of structural steel and reinforced concrete buildings.

The firm of Gibbins & Brown has recently been organized by J. O. G. Gibbons and C. E. Brown. It will specialize in power plants and industrial problems and will be located in Newark, N. J.

The Davenport Electric Company has been formed at Davenport, Ia., by H. M. Heysinger and Richard Copely.

The Dayton-Dowd Company, manufacturers of centrifugal pumps, of Quincy, Ill., announces the opening of a new district office for the sale of pumping machinery in the Pioneer building, St. Paul, Minn., in charge of George M. Kenyon Company. The firm consists of George M. Kenyon, president and general manager; Robert D. Lewis, vice-president; and James C. Willson, treasurer, all of whom are engineers of long standing in St. Paul and are all well acquainted with the power plant, railroad and municipal field.

CLEANING BRICKS WITH PNEUMATIC HAMMERS

A prominent engineering construction company using Boyer type BB chipping hammers made by the Chicago Pneumatic Tool Company, and fitted with extra wide-faced chisels, cleaned 3,000 bricks per day at a saving of 75 per cent in cost over the previous average of 650 bricks per day by hand. The hammers used were 1 3/16-inch bore by 1½-inch stroke, consuming 12 feet of air per minute. The blows delivered by the hammers were not heavy enough to damage the bricks, yet sufficiently effective to remove all old mortar and dirt.

About 100 bricks were laid side by side on the table, forming a comparatively flat 12 x 3-foot surface, which the operator cleaned before turning the bricks for cleaning on the ends and other sides.

With a labor cost of 40 cents per hour, the same as for hand methods, the pneumatic method cleaned five times as many bricks. The cost of compressed air averaged two cents per hour per hammer. The cost per thousand bricks, hand cleaned, was $5.55; mechanically cleaned, $1.26.

A 1,200-FOOT FLORY CABLE WAY

The contractors for the construction of the Gilboa dam have installed on that work for handling concrete and other materials a cableway 1,900 feet long, equipped with machinery made by the S. Flory Manufacturing Co., Bangor, Pa. The towers are 140 feet high and the the S. Flory Mfg. Co., Bangor, Pa. The towers are 140 feet high and the main cable is a Leschen Hercules 2½-inch x 19 Lang Lay rope, parallel to and 6 feet eccentric from the axis of the dam. It is equipped with ¾-inch operating rope, also of the Hercules brand. It is designed to handle loads up to 10 tons with a conveying speed of 1,200 feet per minute, hoisting on a 3-part line at 400 feet per minute. It is provided with an aerial dump controlled by a rope operated by a third drum.

All of the three drums in the cableway hoist engine are placed tandem and are 16 inches in diameter x 48 feet long between flanges. They are driven through machine cut steel gearing by a 300 h. p. General Electric I. T. C. type motor, making 600 r. p. m. and equipped with multiple torque solenoid brakes and operated through full magnetic contactors control with master switch.

PERSONALS

Wheaton, L. H., has been appointed commissioner for the county of Cape Breton, with headquarters at Sydney, B. C.

McCluskey, Jr., W. O., has resigned as road engineer of Ohio county, W. Va., to become assistant division engineer for the third district of the State Road Commission.

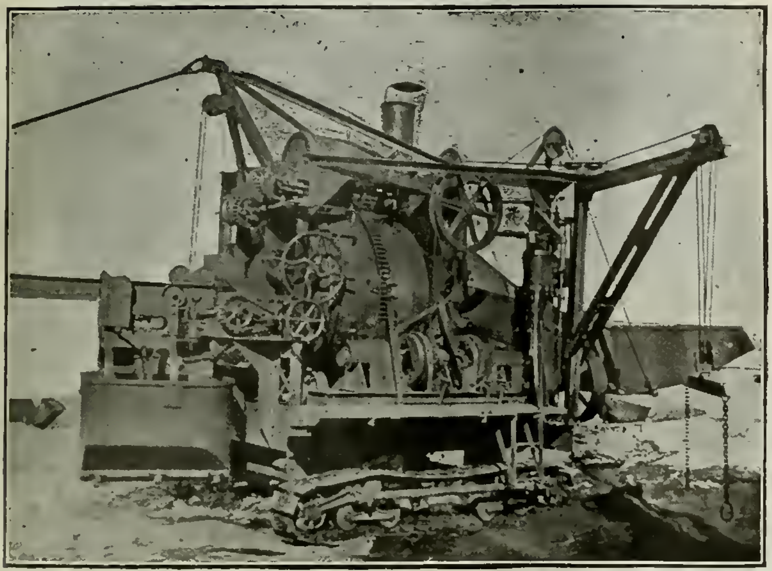
Francisco, J. O., formerly field engineer of the Colorado State Highway Commission, is now road engineer of La Plata county, Colo., in charge of maintenance and construction of 1,600 miles of road.

Brewer, T. M., has been appointed city engineer of Viroqua, Wis.

Dollard, E. C., has resigned as city engineer of Jamestown, N. Y.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



PAVER WITH CAPACITY FOR MIXING DRY BATCH IN 12 SECONDS

RANSOME 21-E HEAVY PAVER

The Ransome 21-E new heavy paving mixer combining unusual speed with positive one-man operation will, it is claimed by the makers, discharge dry mix in from 10 to 15 seconds, with an average time of 12 seconds. In comparing the 21-E with the old 14-E, it is interesting to note that the new paver has 10 per cent less parts.

The control levers are arranged so that without taking a step the man running the machine can easily and continuously carry on all required operations, such as lifting batch boxes from an industrial truck, raising the skip, admitting the water, swinging the boom, dumping the mixer, running the bucket out on the boom, dumping the bucket and returning the bucket to the mixer. The crawler mechanism used is an adaptation of the well-known and thoroughly developed full crawler traction used for "Marion" steam shovels. A friction clutch is placed on the countershaft; and each crawler is furnished with a separate drive. There is a separate band brake for each crawler, which assists in making short turns.

All operations of the crawler are controlled by a clutch lever, reversing lever, steering lever, and two foot brakes.

The drum roller shafts are of cold rolled steel fitted with rollers of car wheel metal 16 inches in diameter and mounted on Hyatt roller bearings. The drum is of all steel plate construction, lighter and stronger than cast steel drums, requires less power for revolving, will not break when pounded, and is less likely to be damaged by the freezing of water in it. The drum roller tracks are forged and rolled from billets of locomotive tire steel. The operator can at all times see into the drum. Every operating part of the machine is easily accessible, and there are no parts revolving when not in use. This point particularly applies to the traction clutches and other driving mechanisms, none of which are running except when the crawler is in use.

"Knocked down," ready for travel or shipment, the Ransome 21-E is but 11 feet in height. Two men and a wrench can dismantle or erect the Ransome 21-E in 30 minutes.

The loading derrick is designed to be placed on either side of the machine, and can be easily shifted from one side to the other. Its height will permit the lifting of a batch box directly from a motor truck. A ratchet is provided for holding the load at any point.

The power loader bucket is of the open end type, wide enough at the bottom to permit motor trucks to dump direct, or for two wheelers to dump at a time. When fully raised the bucket has a 48 degree slope insuring quick, clean discharge. The power loader hoist is equipped with a friction clutch, automatically released when the bucket reaches its maximum height, at which point the clutch brake automatically sets, holding the skip in discharge position.

The paver can be equipped with either steam power, gasoline or electric motor drive. Where steam power is desired, the paver is equipped with a 14 h. p. engine, fully enclosed with counterbalanced crankshaft, and a 16 h. p. boiler built to A. S. M. E. specifications. The exhaust is piped into the base of the stack to increase the draft. A blower is also provided for raising steam before the mixer gets into operation.

With gasoline drive a heavy duty tractor type engine rated at 25 h. p. at 900 r. p. m. is used.

DUPLEX LIMITED

The Duplex Limited four-wheel drive trucks, put on the market by the Duplex Track Company, have been designed in response to a general growing demand for a high-grade truck of medium capacity with unusual speed. It has a four-cylinder motor rated at 25.6 h. p. and developing by actual brake tests 42 h. p. at 1,600 r. p. m. It has a duplex radiator and a 13-inch fan, electric starter and lighter, and direct high speed drive with ratios of 3.66:1, 1.91:1, and 1.00:1 with 4.46:1 in reverse.

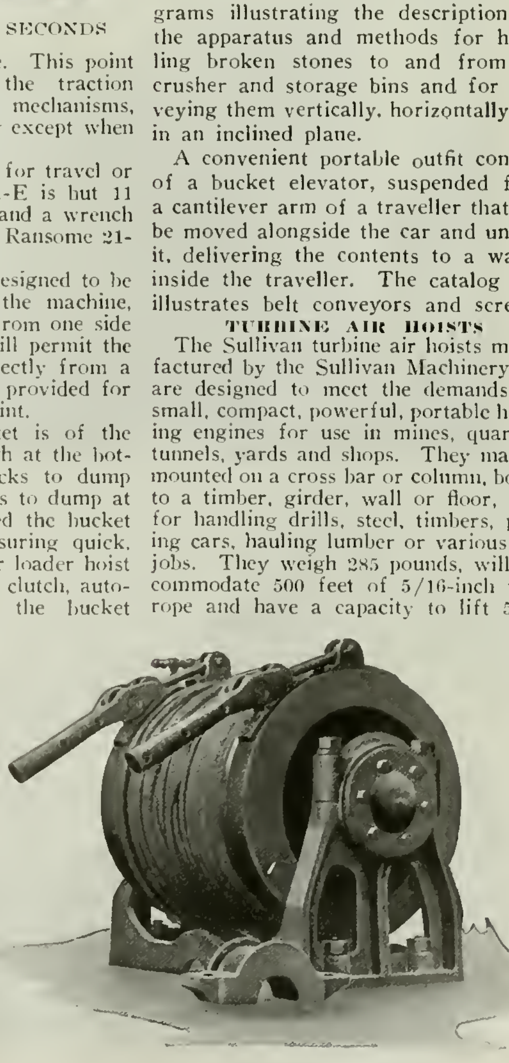
LINK BELT STONE HANDLING MACHINERY

Catalog 416 of the Link Belt Company has numerous halftones and diagrams illustrating the descriptions of the apparatus and methods for handling broken stones to and from the crusher and storage bins and for conveying them vertically, horizontally and in an inclined plane.

A convenient portable outfit consists of a bucket elevator, suspended from a cantilever arm of a traveller that can be moved alongside the car and unload it, delivering the contents to a wagon inside the traveller. The catalog also illustrates belt conveyors and screens.

TURBINE AIR HOISTS

The Sullivan turbine air hoists manufactured by the Sullivan Machinery Co. are designed to meet the demands for small, compact, powerful, portable hoisting engines for use in mines, quarries, tunnels, yards and shops. They may be mounted on a cross bar or column, bolted to a timber, girder, wall or floor, used for handling drills, steel, timbers, pulling cars, hauling lumber or various odd jobs. They weigh 285 pounds, will accommodate 500 feet of 5/16-inch wire rope and have a capacity to lift 5,100



SULLIVAN TURBINAIR HOIST

pounds dead load 100 feet vertically per minute under 80 pounds air pressure.

The turbine air motor and the remainder of the operating mechanism are completely enclosed in the steel drum and, using the air expansively are economical for power and have long life and sustained sufficiency. Some of the turbines have been in use for 5 years without requiring repairs.

It has friction clutch and brakes and when the former is locked in position the load can be raised, lowered and controlled entirely by the use of the throttle valve. It is rated at 4½ h. p., has dimensions of 32½ x 50¾ inches overall, and the drum is 9½ inches in diameter and 9½ inches long.

AUTOCAR MOTOR TRUCKS

The Autocar motor trucks, manufactured by the Autocar Company, are made with low sides, rotary dump equipment and bodies having 1, 1½, 2 and 3-yard water level capacities with platform bodies fitted with rocker bottom 1-yard Lee end dump dual hopper equipment.

In building the 5-mile route 225 on the Pennsylvania State Highway between the Baltimore Pike and the Westchester Pipe, Delaware county, dry aggregate was hauled a maximum distance of 6½ miles with 2½-ton loads daily at a cost of $.30 per ton mile. The 20 trucks installed by the hauling contractor had rotary dump bodies with a special division board across the center, enabling them to carry two batches at once. They were loaded by gravity from overhead bins in two minutes and having a wheel base of only 97 inches, were easily turned on the concrete roadway only 18 feet wide before they were backed to the hopper of concrete mixer and unloaded in about two minutes. Twenty trucks were used on the long haul and produced an estimated saving of 16 men at $6 per day, equivalent to eight or ten cents per square yard of the concrete laid.

AUTOCAR ON ROUTE 225 PENNSYLVANIA STATE HIGHWAY

AUTOCAR ON JEFFERSON HIGHWAY

AUTOCAR ON JEFFERSON HIGHWAY

In the construction of 12 miles of the Jefferson Highway at Des Moines, Ia., six Autocars with Lee bodies hauled the dry mixture 5½ miles from the railroad siding to the concrete machine, making the round trip in 40 minutes and together handling 180 tons of materials daily.

In the construction of Route No. 127, Section No. 3, of the Baltimore-York Pike, Pennsylvania, Autocars equipped with platform bodies and oversize pneumatic tires, each hauled two steel batch buckets of dry mix from 3 to 4 miles to the concrete machine and dumped by hand into the loading skip of the mixer. An average of 10 trucks served the mixer, laying 350 to 500 feet of 18-foot concrete highway daily.

PERSONALS

Hoffman, Alexander G., has been appointed county road engineer of Ohio county, W. Va.

Rodenberg, E. R., has been appointed chief engineer of the East Side Levee and Sanitary District, East St. Louis, Ill.

Brooks, Clarence M., has been appointed deputy commissioner of highways for Vermont, and will be directly in charge of road maintenance work.

Smith, Burton, chief engineer of the Oakdale (Cal.) irrigation district, has resigned to become superintendent and chief engineer of the Merced irrigation district.

Givan, Albert, has been appointed city engineer of Sacramento, Cal., to take office when the new city manager plan goes into effect.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 51 JULY 23, 1921 No. 4

Liberty Tunnel, Pittsburgh

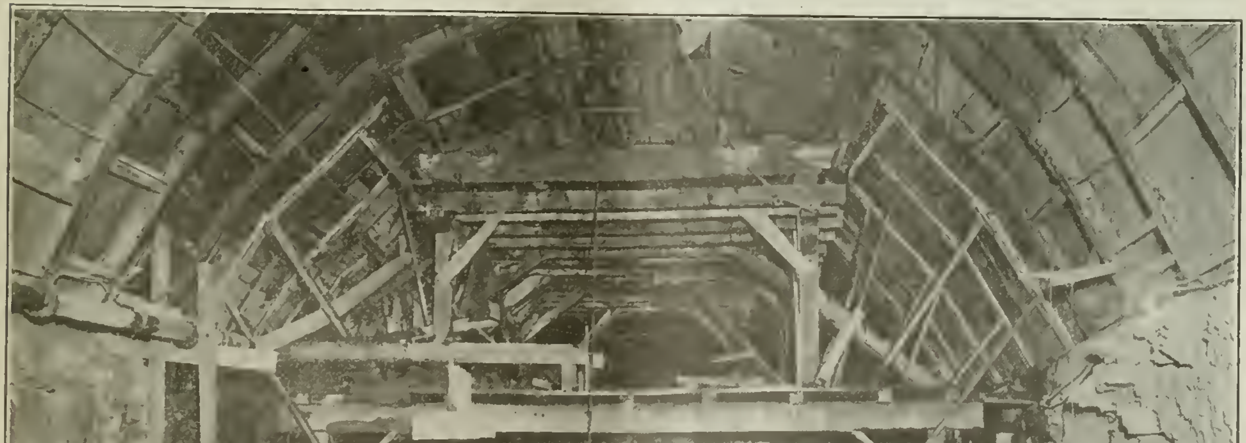
Construction of twin vehicular tunnels 26 feet wide, 5,750 feet long and about 350 feet below the surface. Long sustained record progress secured by ample drilling equipment, steam shovel mucking, improved concreting methods and an efficient force of 250 men in two full-size rock headings. About 12,000 yards of concrete and 24,000 yards of excavation saved by substitution of steel for wood timbering.

The Liberty Tunnel, Pittsburgh, now under construction through South Hills, will connect the business part of the city with the high-class residential district of West Liberty, Dormont and Mt. Lebanon, and adjacent suburbs, and is intended to be used exclusively for passenger traffic and the domestic supplies of the district served.

DESIGN

There are twin, concrete-lined, horseshoe-shaped tunnels, 59 feet feet apart on centers and about 5,750 feet long, with approaches extending the total length to 6,289 feet. Each tunnel has an electric railroad track, a 13½-foot driveway, and a 4-foot sidewalk, the driveway being intended for a one-way traffic of 1,690 vehicles per hour, moving 100 feet apart in two lines at a speed of 15 miles per hour. This is probably much more than will actually be realized for several years.

Under this traffic it is computed that there may be discharged into each tunnel 170 cubic feet per minute of poisonous carbon monoxide gas from the automobile engines, and that for its dilution to a harmless proportion it will be necessary to ventilate the tunnel with a supply of 280,000 cubic feet of fresh air per minute per tunnel. A system of ventilation has accordingly been devised to meet



WORKING PLATFORM FOR PLACING LAGGING ON BOTTOM FLANGES OF ROOF I-BEAMS this requirement and the plans are now being completed to secure its operation in any efficient and economical manner. Such an installation will be of great interest and value in the case of other long vehicular tunnels where the disposition of noxious gases from automobiles is a serious matter, the proper treatment of which has not yet been practically demonstrated.

The tunnels were designed by and are being constructed under the direction of chief engineer, A. D. Neeld. Booth & Finn, Ltd., is the contractor. M. L. Quinn is the general superintendent, and John B. Sweeney, engineer. The work is being executed under a contract awarded by Allegheny county, December 2, 1919, at unit cost prices which amount to about $1,600,000, on the basis of the estimated amounts involved.

GENERAL CONDITIONS

Difficulty was experienced in securing a suitable disposal for the muck from the north end of the tunnel, so that operations were first commenced at the south portal only, and on June 22, 1921, the tunnels at that end had both been driven to a total length of 1670 feet from the portal. Plant has now been installed at the north portal also, and operations were commenced there about June 1st. The work is now progressing more rapidly than is called for by the schedule, and it is expected that it will be completed before the expiration of the time limit.

The tunnels are not driven, as has been published, through "good shale," but so far as they have been excavated, and according to indications for the remainder of the distance, are located wholly in green clay, red clay and soft laminated sandstone and for a short distanec through good blue sandstone, which is the only one of the different materials that is not very treacherous and dangerous to excavate.

FIRST TOPHEADING METHOD

The excavation averages about 33 feet in width and 26 feet in height, running 30 cubic yards per linear foot of tunnel. The two tunnels are parallel tangents and the headings are driven simultaneously and at about the same relative position in each tunnel. There is a uniform down grade of 0.392 per cent from the south portal to the north portal, but as little or no water is encountered there is no drainage difficulty.

As the blue sandstone disintegrated by exposure to the air, the quarry face at the south portal was safeguarded by removing the unsound rock and exposing the sound rock, which was covered with concrete 2 inches thick, applied by a cement gun. A portion of the rock base at the south portal having been undermined, it was supported by a concrete retaining wall 12 feet high and 30 feet long, which provided for the safety of the workmen and forms a portion of the permanent structure.

Work at the south portal was commenced on the 30-foot high face of an old blue sand-stone quarry. In each tunnel there were driven two 6 x 6-foot drifts, one on each side at the spring line, and a third drift of the same size at the crown. These were carried in about 30 feet and then connected by excavations about 6 feet high, reaching from the crown to each of the side drifts and exposing the rock surface of the whole tunnel roof, which was immediately protected by a permaent arch of 7 segments of 12 x 12-inch timbers set close together and under this roof "dumpling," marked 3 in the diagram, was removed down to the spring line, after which the remainder of the excavation down to the invert was removed in a single bench.

SINGLE WIDE HEADING AND HIGH BENCH

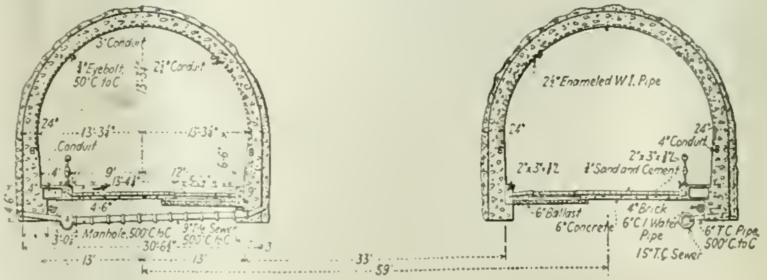
Beyond the 30-foot point the method was changed, and the tunnel was excavated with a full width heading 10 feet high and a single bench 16 feet high which was kept only 5 or 10 feet back from the heading, thus practically making the excavation in a single fullsize heading, the bench only serving as a convenient platform for drilling.

The heading is drilled with 45 holes, 15 feet deep, and the bench has channelled sides and 12 vertical holes. The rock is blasted with from 1½ to 2 pounds of 40 per cent dynamite per cubic yard of excavation. Drilling and shooting is done at night by a gang in each tunnel working an 8 to 10-hour shift. The mucking is done by mucking gangs in the 8 to 10-hour day shift. The system of working only two shifts allows for either to overlap in case of necessity. In some cases as much as 7 hours have been lost in one shift by a breakdown of the steam shovel and regained in the same 20-hour day by concentrating in this heading the muck cars and locomotives from the other tunnel.

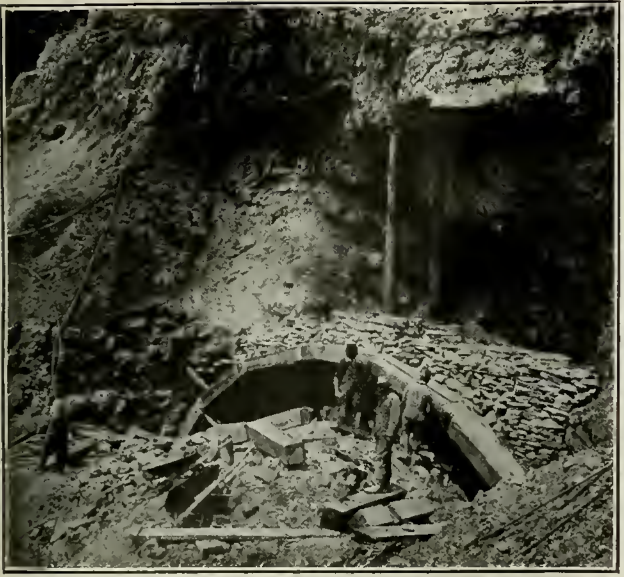
The muck is handled by a No. 11 compressed air operated Marion steam shovel with a 1½-yard bucket in each heading that loads the 4-yard heavy-duty Western side dump cars that are hauled in 5-car trains to the south portal by electric locomotives and thence to the McKinley City Park by one Climax geared locomotive and three Vulcan locomotives. After the completion of this fill it is intended to deliver the muck for use in the foundations of the Knoxville boulevard, which will thus be built up to a height of 35 feet without cost to the city.

AIR SHOVEL MUCKING

As fast as the tunnel is driven there are laid on the invert two 36-inch service tracks with 80-pound rails. On one track there is maintained at the head-



SECTION OF LIBERTY TUNNELS AT MANHOLE AND AT INTERMEDIATE POINT



SOUTH PORTAL EXCAVATION AND GROUTED ROCK OVER EAST TUNNEL HEADING

ing an electric locomotive and train of empties and full cars, both of them close to the air shovel that is located between the two tracks. The two tracks are connected by a switch in the rear of the shovel, and as fast as a car is filled the 5-ton locomotive pulls it back, moves an empty up to the shovel beyond the switch, and returns to the opposite side of the switch, permitting the other locomotive to cross the switch and haul the full car to the opposite track, and so on until the entire train has been loaded in about half an hour, without any lost time for the shovel.

ROOF SUPPORT

Blue sandstone has been encountered only for the first 300 or 400 feet from the south portal; the remainder of the excavation has been, since then, through very treacherous material that rapidly decomposes by exposure to the atmosphere, so that the roof requires to be supported immediately, and if there are indications of falling before the permanent timbering and lagging can be put in it is temporarily posted to protect the workmen.

Wood timbering was used only for the first 30 feet of tunnel next to the south portal. In the remainder of the work 12 x 12-inch arch segments have been replaced by 8-inch 32-pound H-beams of the same length, weighing about 200 pounds each, that are bolted together with two web plates and one inside flange at each joint. They support 3-inch wooden longitudinal lagging strips. The voids outside of the latter are carefully filled with selected sandstone, hand packed. The lower ends of the bottom segments of each bent are seated on steel bearing plates that in turn rest on bevelled blocks fitted into the side walls, except in occasional cases where the rock is not sound or has been blasted too far away, when wooden vertical posts are provided.

The H-beams, set from 2½ to 5 feet apart on centers, are considered very economical and satisfactory and develop enormous strength if the latter is computed from a deflection of 3 inches in a 7-foot span, which gives a maximum stress of 25,000 pounds per square inch in the flanges, which is safely carried. The use of H-beams for this purpose is believed to be unprecedented and they are considered stronger with a spacing of 5 feet on centers than are 12 x 12-inch wooden timbers 3 feet apart on centers.

Steel was adopted, both on account of the excessive cost of timber (about $65 per thousand feet B.M., unframed) as compared with the cost of the H-beams cut to length at the mill, and because of the very important saving of 2 yards per linear foot in the rock excavation and one yard per linear foot in the concrete lining for each tunnel, items that together amount to a large sum for the completed tunnel.

Where wooden timbering is used it is required to make the excavation large enough to keep the timbering entirely outside of the neat line of the concrete work. The steel H-beams however are classified as reinforcement for the concrete lining and are allowed to project inside the neat line into it, thus reducing the dimensions of the cross sections of both the excavation and concreting, by an average amount of about 10 inches around the entire circumference of the tunnel above the invert.

CONCRETING

Aggregate, delivered over a spur of the railroad track, is stored in a 1,000-ton hopper-bottom bin of seven compartments, with a cement house on top at the track level. The bins discharge by gravity into a measuring car on a track underneath. The cement is spouted in 4-bag lots through an 8-inch pipe to the car. The car descends by gravity on a 1 per cent grade to the 4-bag Ransome mixer and

SIDEWALLS AND FORMS AND TRAVELING INCLINE FOR CONCRETE CARS is hauled back empty by a Little Tugger hoisting engine operated by compressed air.

The mixer is at present operated at the rate of about 1,800 cubic yards per week, which is discharged into 36 1½-yard cradle-dump cars of the Lakewood and Koppel types, lowered by a hoist to the tunnel grade 600 feet from the portal, and then hauled by electric locomotives in 7-car trains to the forms, where they are drawn up an incline to the level of the spring line and dumped directly into the forms for the side walls.

Concrete for the arch is delivered to a Caniff-Ransome pneumatic conveyor machine under the platform, and is then delivered through a 6-inch pipe of a maximum length of 100 feet with two long radius bends, to the level of the crown of the arch, where it is discharged through a two-way tee to both sides of the arch and is so thoroughly spaded that it is very compact and no finishing is found to be necessary when the forms are stripped. As the concreting approaches the crown the tee is removed from the end of the discharge pipe and the concrete is delivered directly against the face of the key, about 2 feet wide, as the pipe recedes from the concreted arch.

ERECTING STEEL FORM FOR ARCH CONCRETE. WEST TUNNEL. NOTE ROOF I-BEAMS

The separate side wall and arch forms about 30 feet long were designed by Mr. Sweeney, approved by Mr. Neeld, and manufactured by the Blaw-Knox Co.

The tunnel is required to be waterproof and after the contractors and the membrane waterproofing company had worked for many weeks without success to devise proper methods of applying membrane waterproofing, the attempt to use it was abandoned, and the engineer imposed the alternative of grouting the roof and walls under 300 pounds pressure applied through seven 2-inch pipes installed in every 15 linear feet of the tunnel. The lining is accordingly grouted with a Cockburn Barrow machine as soon as convenient after the concrete has satisfactorily hardened.

RAPID PROGRESS

The excellent planning and organization together with the amount and quality of construction equipment installed and the efficient direction of the work have enabled the contractors to establish a new record for tunnels of this size and character, maintaining a progress of 10 feet per day continuously for 6 days a week for the months of March, April and May, last, when there was an average of 620 yards of muck removed in two shifts every twenty-four hours.

These results were undoubtedly promoted by the policy of encouraging the men, who were allowed 11 hours pay for 9 linear feet of tunnel and 12 hours pay for 10 feet, no matter how quickly the work was actually done. They were also provided with a black flag and an American flag, the first shift out of the tunnel having the privilege of displaying the American flag the following day, while the other shift was required to display the black flag.

Besides the equipment already mentioned the contractors have installed 65 Ingersoll jackhammers and 6 Waugh hammer drills, 3 Ingersoll Rand Imperial type air compressors, direct conected with electric motors, two direct connected 60-cycle 2-20, three-phase Westinghouse generators for the electric locomotives.

The principal quantities involved include the rock excavation in the tunnel, 127,000 yards of rock excavation in the approaches ,about 9,000 yards of concrete in the portals and retaining walls, concrete in the tunnel lining, about 220,000 pounds of reinforcement, 6,600 square feet of brick and 1,575 square yards of stone block paving in approaches, 12,640 square feet of sidewalk in approaches, about 1,000 cubic yards of concrete in an arch span in the approach, and about 2,000 sets of H-beams having a total weight of about 2,800,000 pounds.

The contract price per linear foot of tunnel is $722, of which the specifications provide that an estimate of 45 per cent shall be made when the work is ready for the masonry lining up to an elevation of about 3 feet above the spring line, 19 per cent for the excavation below the heading excavation, 26 per cent for the masonry lining including the terra cotta and wrought iron conduits, 3 per cent for paving, and the remainder for various small items. Ten per cent of the whole is retained until the final estimate and acceptance of the finished work.

More Hydroelectric Power For Alabama

The Alabama Power Company furnishes a large part of the electric energy used throughout the state and has been a conspicuous factor in the development of the state. Practically all of the power that the company is able to furnish with its present facilities is being utilized and it is now preparing to construct another dam at Duncan's Riffle on the Coosa river in order to add greatly to the amount of power that it can furnish. The Federal Water Board has given the company the necessary permit and the company has borrowed $25,000,000 for carrying out the construction. It is stated that the construction of the dam will require the employment of

1,500 to 2,000 men for a period of eighteen months or possibly two years, and that work will be started at once.

Jamestown's Municipal Milk Plant

Last year, as stated in the September 25th issue of Public Works, the taxpayers of Jamestown, New York, voted to bond the city for $150,000 for the construction of a municipal plant for pasteurizing milk and distributing it to the inhabitants of the city, having obtained about four years previous a special act of the legislature specifically authorizing it to issue bonds and operated a municipal milk plant. The project has been held up because attorneys for the bond buyers have raised the question as to constitutionality of the proposed innovation and consequently the city has been unable to sell the bonds and begin the proposed undertaking. Mayor Samuel A. Carlson informs us that it is expected that steps will be taken very soon for a friendly suit to test this point.

Baltimore's Public Works

Results obtained and put under way during the past twelve months in the water works and highways departments.

In 1918 the State Legislature extended the limits of the city of Baltimore to enclose nearly three times the area of the city as it had previously existed, or from 32.19 square miles to 91.93 square miles. There has been published in the June 10th issue of the "Baltimore Municipal Journal," the official city organ, a resume of the work done by the present administration, which has been in power since that time. Certain of the more interesting and important items of this report are given in the paragraphs below.

Politics prevented securing department heads in sympathy with the aims and aspirations of the administration for the first six months, but finally council co-operated and confirmed the various appointments. One June 1, 1920, Henry C. Perring was appointed chief engineer of the city, a position that had been vacant for several years, and took office immediately. Mr. Perring heads the Department of Public Improvements and as such has aimed to secure the hearty co-operation of all the various subdepartment heads. The various branches of the public works are placed in charge of the Public Improvement Commission, which has jurisdiction over the expenditure of a $15,000,000 loan for water works and a $26,000,000 loan for schools, paving, bridges, sewers, conduits, harbor, police and fire protection. The Port Development Commission is spending $10,000,000, with an authorized loan of $50,000,000, for the general development of improvement of the harbor. The board of school commissioners, paving commission, electrical commisssion, highway engineer's department, water department, harbor board, law department, fire department, health department, board of park commissioners, city service commission and others have charge of the different services indicated by their titles.

WATER WORKS

The largest single project authorized and undertaken by the public improvement commission is that of the Loch Raven dam and the other water works construction connected therewith. As already noted in Public Works, it is proposed to raise this dam 52 feet above its present height, which will increase the storage to 22,000,000,000 gallons, which is ten times its present capacity, and will supply sufficient storage for the needs of the city for the next 25 years. The Gunpowder river is the sole source of water supply for Baltimore and with the recent rapid growth of the city the municipality was threatened with a water famine because of the insufficient storage, although the flow of the river is ample. Messrs. Hill and Fuertes, consulting engineers, made recommendations some time ago covering the supply of Baltimore for the next hundred years and the work now under way is the first step of the program they recommended.

The city has just completed negotiations for the purchase of the Baltimore County Water and Electric Company for $2,598,335. This company has supplied water to a considerable part of the territory recently annexed.

"The water department last year began a drive for conservation and as a result of the methods undertaken to stop leakage and waste, a great saving has been effected. This may result in the postponing of the extension of the filtration plant which would involve a capital expenditure of $1,250,000, and additional operating costs. The survey of underground leakage is now in progress, in addition to the inspection of plumbing fixtures in houses."

As a result of the progress so far made, the consumption of water has been reduced about 20 per cent and millions of dollars have been saved to the city. Last year a 30,000,000 gallon centrifugal pump was installed at the Mount Royal pumping station and the tests indicated that it is perhaps the most economical pump of its size that has been built in the United States.

HIGHWAYS

The highway engineer's department is divided into the divisions of sewers, highways, permits and bridge and improvement. A program of sewer extensions totaling $2,500,000 has been approved for this year. It is unlikely that this amount will be expended before the end of the year. Since January first, 1920, this division has built 27 miles of house sewers and 12 miles of house connections, 8 miles of storm water sewers and 2 miles of clear water drains.

The highway division has charge of repairs of the highways, but not of new paving. Since May, 1919, over one and a half million square yards of repair paving have been laid and in addition 936,000 square yards of roadway has been resurfaced. Under the emergency labor program, when the wave of unemployment was at its highest, about 500 men were put to work spreading cinders on some of the roads which were complained of as being in bad condition and about 40 miles of roadway 20 feet wide were so covered.

Of new paving comparatively little has been done during the past few years. A $5,000,000 paving loan approved in 1911 was expended by 1916. From then until 1919 a system of borrowing in anticipation of the collection of the special paving tax was employed but could not be continued after that date. Add to this the increase by about 100 per cent of the cost of paving in 1920, and the slowing down of the paving program is easily accountable for. During 1919 and 1920 the paving commission laid about 19 miles of pavement at a cost of $1,675,000.

"One of the innovations of this commission is the so-called fifty-fifty agreement which was originated by the Board of Estimates, under which the developer of a tract of land must pay one-half of the cost of paving new streets in his development. This agreement was recently amended to impose upon the developer the obligation of reducing his streets to grade before the city will undertake the paving even under the fifty-fifty agreement."

The paving program for 1921 includes about 25 miles of streets and alleys, and contracts totaling $825,000 have been let in the first six months of this year and 6 miles of paving have been actually completed.

One of the results of the co-ordination in the development of public improvements is the putting into effect of a plan for giving advance notice of contemplated paving and requiring that all underground improvements be completed before the pavement is laid. This has ended the evil of tearing out new pavements for the installation of water mains, conduits, etc.

MUNICIPAL EMPLOYMENT BUREAU

During the winter of 1920-21 thousands of men were thrown out of work in the city. This condition had been anticipated and a municipal employment bureau had been established by a committee appointed by the mayor. The city, in order to employ the men, undertook improvements which, while necessary, were not urgent and could have been done at a later date. The men were paid only 30 cents an hour, but the low wage scale was justified by the fact that they could not, on account of weather conditions, give greater value to the city by their labor. Thousands of men were given employment and the program was approved generally. This bureau is still in existence and will probably be maintained as a permanent institution.

California Sub-grade Experiment

Following the report of the Federal engineers which called attention to the injurious effect of an adobe or alkaline sub-grade on the thin concrete pavements laid by the State Highway Commission of California, that commission has been conducting experiments on the road between Mojave and Lancaster, with the use of oil applied by the penetration method to the sub-grade, with a view of insulating the concrete from the alkali in the soil. On another section of the highway, where the soil is adobe, the engineers are placing a 4-inch cushion of gravel over the sub-grade. Similar experiments are being conducted west of Lemoore in Kings county.

Some of the oil macadamized highways built by the San Joaquin county are to be widened by the State Highway Commission by building a 30-inch concrete shoulder about 8 inches thick on each side of the existing pavement, which will be scarified and re-rolled and re-surfaced with asphalt concrete to an aproximate thickness of 2½ inches. About $20,000 is to be spent on this experiment.

Bureau of Municipal Research

The New York Bureau of Municipal Research has ceased to exist, having been combined with a new corporation known as the National Institute of Public Administration. This institute plans to train men and women in the practical work of public administration. The acting director is Luther Gulick, Clarence B. Smith, Jr., is manager and Raymond B. Fosdick is counsel. The names of men well known in the field of municipal finance, engineering, public health, city planning, etc., are listed as instructors, lecturers and consultants. The office of the institute is at 261 Broadway, New York.

Mile of Concrete Pavement a Week

Work on a 21-mile contract, done from a central mixing plant with a record of 1,694 square yards in one day, and from a central proportioning plant, delivering 36-cubic-yard train loads of cement and aggregate in 2-yard batch boxes.

In the construction of 21 miles of the Joliet-Morris 18-foot concrete highway, which is a part of the Federal Aid road between Chicago and St. Louis, the Powers-Thompson Construction Co., contractor, has installed equipment for simultaneous prosecution of the work from two points, at which central mixing and central proportioning are carried on under similar conditions, making valuable comparative results.

Although the alignment generally has few curves and light grades, there was considerable excavation to be done and the coarse gravel was handled by elevating grader machines. Sand and gravel are obtained from a large local gravel pit with a short haul that eliminates freight charges. Concrete is proportioned 1:2:3½. Operations were commenced in September, 1920, and eight miles of road were completed that season when a record progress of 837 linear feet of road was made with one of the two plants, involving a haul of about one mile for the mixed concrete.

The work is being prosecuted from two central plants, at one of which there is a Koehring 28-E mixer installed near the plant of the Chicago Gravel Company. At the other plant elevated sand and gravel storage bins, adjacent to a railroad track, deliver the aggregate for distribution dry to the paving machine that is working toward the other plant. Both the central mixing plant and the central proportioning plant can be shifted if necessary as the work progresses and the hauls become too long for them.

At the central mixing plant the concrete is discharged to six large trucks rented from the State of Illinois, that haul it over a good road to the required point, with a record for hauling 290 batches about 1 mile in one 8½-hour day, last fall. This season a record has been made for hauling 200 batches five miles in one day, thereby laying 630 linear feet of pavement as compared with the 847 linear feet last fall, with the one-mile haul.

At the other plant the aggregate is delivered from bins into 2-yard Western batch boxes, loaded in pairs on the trucks of Western 8-yard dump cars from which the boxes have been removed. These are hauled in 7-car trains by 12-ton locomotives, except at a long 4 per cent grade where the trains are split and three of the cars are hauled up the grade by a 5-ton truck, after which the remaining four are hauled up by the locomotives, which takes the whole train to its destination. After the proportioning plant has been moved beyond this grade, 9-car trains will be hauled by a single locomotive.

The batch boxes are unloaded and the paving mixer is hauled along on the subgrade by a Bucyrus crane mounted on crawler traction. The mixing machine is handled by one operator, and one assistant and two men puddling and spreading concrete; besides which there is one man to handle the crane, one to handle the finishing machine and the others for preparing subgrade, setting forms, covering and screeding the concrete and other miscellaneous work.

The Meridian International Highway

Early this year, D. E. Colp, of San Antonio, and Fred W. Mally, of Laredo, Texas, officials of the Meridian Highway Association, in conjunction with the Department of Communications and Public Works of the Republic of Mexico, began a campaign to extend the Meridian highway from the Rio Grande to Mexico City.

In the United States this highway begins at Laredo, on the Rio Grande, and extends northward to Winnipeg, Canada. Through three-quarters of Texas the road either has been paved or is under construction. In Oklahoma, bridges crossing the Canadian river have been built or are under way, and in South Dakota the bridge crossing the Missouri river is under construction. North of Texas all of the highway has been graded and much of it has been graveled or paved. The highway has been "signed" for the entire distance, and with the completion of the work being done this year and the bridges, it will be open for traffic from the southern to the northern boundary of the United States.

In Mexico the Obregon administration, through the Department of Commerce and Communications, is enlisting the interests of the state governments and co-operating with them for the continuation of this road to Mexico City. At the invitation of the Mexican government a party of 14 .United States citizens visited Mexico City in May, stopping at several of the principal cities along the proposed route of the highway. This party included Mr. Colp, the vice-president of the association; Mr. Mally, secretary of the Laredo chamber of commerce; and G. A. MacHaughton, the Texas secretary of the association; also the entire state highway commission of Texas, with others from Oklahoma, Nebraska and South Dakota. Ben Baines was assistant secretary and E. A. Kingsley was engineer for the party. Two engineers of the Mexican Department of Commerce and Communications and two officials of the Mexican army acted as escort to the party.

On its way to Mexico City it stopped at Monterey, Saltillo, San Luis Potosi and Queretaro; at each of these, conferences were held with the governors of the four states in which the several cities were situated and in addition representatives from other states joined the party for conference.

At Mexico City the secretary of the Department of Communication and Public Works, Faustino Roel, outlined his plan for a system of interstate highways that would link into the United States highways at Laredo, Brownsville and El Paso. He assured the delegation that the Mexican government was thoroughly in earnest regarding the development of a system of national highways and obtaining at least one international highway. The various Mexican highways would all lead to Mexico City. The Mexican government believes that the construction of good roads throughout that country will facilitate the rapid movement of the rural police and eventually eliminate the bandit curse.

Much road construction is now being done by the various Mexican states and by the national government. Some of this is of a permanent nature and some merely grading and graveling. All culverts and bridges built are of permanent construction types. Grades and road widths are planned for the future and for ultimate permanent work. The Mexican highway engineers are men of much ability and are doing excellent work. Many of them received all or part of their education in colleges of the United States. Jorge Nunez, one of the engineers who acted as host to the party, is a graduate of the University of Pennsylvania.

The visiting Americans were conducted to various sections of the country convenient to the capital and were impressed with the amount of building that was going on, factories being installed and the changes in the educational methods, free public schools being installed and education being made compulsory. They were also impressed with the fact that there was no animosity felt towards citizens of the United States, but that a feeling of cordiality was everywhere apparent.

Laying and Repairing Six-Inch Submarine Pipe*

By James W. Graham

Wrought iron pipe was laid in Portland harbor by scows. Later it was broken by an anchor and was repaired with great difficulty.

Peaks Island is located in Casco bay about two miles from the city of Portland, Me.

The water supply for the island has for some years been obtained from driven wells, but during the summer of 1919 the wells did not furnish sufficient water to keep the higher parts of the island supplied.

The population of the island in the winter is about 1,000, but in the summer season it reaches 7,000 and on holidays is perhaps 10,000. The wells supply ample water for the winter population, but the need of more water during the vacation season was apparent.

The city has an abundant supply of excellent water, but the cost of carrying it to the island by the ordinary method of flexible-joint cast-iron pipe was prohibitive. It was therefore decided to lay a six-inch galvanized wrought-iron pipe of standard weight, using recessed couplings. At sharp changes in the grade, Moran flexible cast-iron joints were installed.

The bottom of the harbor on the route selected was soft, blue clay and silt for a considerable part of the way and, except where the tide had carried away the silt, the pipe would sink about a foot and a half into the mud. In some places, where the clay was fairly hard, the pipe lies on the mud, exposed to the sea water.

As fresh water freezes at 32 degrees and salt water at 27 degrees, and each winter the water in Portland harbor reaches 28 degrees, it is a question yet to be decided whether this line can be maintained in operation throughout the year. It is feared that enough of the line may be exposed to the flow of sea water to reduce the water inside the pipe to 32 degrees.

There was no ledge on the selected route except on the land sections; and no logs or other obstructions, so that the pipe was well supported along its entire length.

The line adopted left the east end of the city on an easy grade so that 1,800 feet from shore there was only ten feet of water at low tide. The next 1,600 feet was a ship channel having 30 feet of water at low tide with gently sloping side banks. Beyond this channel the pipe reaches a part of the bay where for 5,200 feet the depth of water varies between 10 and 17 feet at low tide. Next comes a channel 30 feet deep and 800 feet wide and then the flats leading to Iittle Diamond Island. The line then crosses this island for 1,500 feet and rises to a height of 40 feet. Between this island and Peaks Island is 2,500 feet of water reaching a depth of 25 feet with gently sloping banks.

The rise and fall of the tide in Portland harbor is 9½ feet, so that a part of the line was laid in 40 feet of water.

The total length of submarine pipe is 12,025 feet, or about 2¼ miles.

For the purpose of laying the pipe, a flat-bottom scow was engaged. The boat was 26 feet wide and 56 feet long and draws about 3 feet of water when carrying no load. The sides stood 3 feet out of water and it was decked over. It carried a mast with derrick boom and a steam hoisting engine forward and had a cabin in the stern. Stanchions at each corner were very useful for fastening anchor lines.

A small tug was used for transporting the crew and moving the anchors used for holding the scow in position.

The crew consisted of an engineer and deck hand on the scow, one man on the tug, three seamen, five pipemen and a foreman.

It was desired to begin the construction of the line as early in the spring as possible, but the prevailing wind storms during April held back the beginning of construction until about May 1, 1920.

In beginning the work, as much pipe was put on the deck of the scow as was possible without interfering with the working deck space, and still more was stored in the hold. The scow was then towed around to the point of beginning on the shore of the city.

Four 600-lb. anchors were provided, two having 1,200 feet of 3½-inch manila rope each and two having 600 feet each of the same rope. Each anchor had a 75-foot drag line with a wooden float attached to one fluke.

The tow boat carried an anchor several hundred feet off from each corner of the scow and dropped it to the bottom. The scow was held in position by these four anchors, one leading from each corner, and was pulled in the desired direction by passing the proper anchor lines to the steam winch. When it was desired to move the anchors, the tow boat would pick up the float attached to the fluke of the anchor and by pulling the line up short had no trouble in dragging the anchor to the desired position.

At high tide ten twenty-foot lengths of pipe were dropped overboard near the high-water mark and at the following low tide the pipe was screwed together and left lying in position on the mud with one end at half tide.

The following high tide the scow was pulled near the low water end of the pipe and the end of the pipe was raised to the deck of the scow. (The scow lay at right angles to the line of the pipe so that the work was done near her center. When she was pulled ahead she went sideways.) The next piece of pipe was then screwed into the line with a 6-foot chain tongs. It was screwed up to refusal with five men on the tongs, and the pipe threads out of sight within the recessed coupling. Each end of the coupling was then painted with red lead and oil.

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*Paper before American Water Works Association.

The scow was then pulled ahead 20 feet and another piece of pipe inserted in the line.

When the depth of water became greater than 15 feet, a rope was passed under the pipe and over a plank lying across two dories. On this plank was a cleat to allow the pipe to be easily lowered. When the depth of water exceeded 25 feet, two sets of dories were used. The distance between these supports was about 150 feet.

The pipe was left suspended to the scow and dories at night when the wind did not blow hard enough to rock the scow to any extent, but in rough weather the pipe was lowered to the bottom and picked up the following morning. We were not forced to lower the pipe and pick it up again in the deeper parts of the line.

When the scow finally approached the island shore, the pipe was laid in the regular way at high tide to a point well above low water and at low tide, men working on the flats connected up additional pipe. When the pipe end was lowered into the water it was carefully plugged in order that no water might get inside.

The work was carried on the same way between Little Diamond and Peaks island. The distance was 2,500 feet and the water was comparatively shallow.

The wrought iron pipe was carried up to a point near half tide, where it was connected to cast iron pipe by a cast iron sleeve. Those parts of the line crossing Little Diamond island and on Peaks Island and in Portland necessary to connect with existing mains were laid with cast iron pipe.

The line crossing Little Diamond island, about 1,500 feet in length, was laid on the surface of the ground and the joints were made of "lead-hydro-tite." It took two days for our men to learn to handle this compound, and then the work proceeded smoothly. It became evident that a gasoline burning furnace built especially for melting this material was very essential and would pay for itself in a short time.

After the entire line was installed and had been working a few days, a two-inch Empire meter was installed at the Portland end on a by-pass and the gate at the far end was closed over night. All water entering the line passed through the meter. The reading of the meter the following morning showed that the line was perfectly tight, the meter not having moved.

In October it was decided to bury the land portions of this line below frost. This involved lowering the 1,500 feet across Little Diamond island, a part of which was ledge. This was accomplished by making the trench along side the pipe line, and the blasting was done without disturbing the line. The pipe was then lowered into the ditch a little at a time without shutting off the water for more than an hour or so.

The lead-hydro-tite joints stood this moving successfully. A few of them leaked a little when first lowered, but the ditch was left open for a few days and the leakage stopped.

On the shore of Peaks island a 6-inch Empire compound meter, a 6-inch Ross pressure regulator, and a 6-inch check valve were installed with proper by-passes. On Peaks island is a standpipe with the overflow at an elevation of 135 feet above the tide water. On the Portland end, the supply for the line was equal to a head of 250 feet above tide.

The Ross regulator was set to close when the water in the standpipe was 3 feet below the top and during the night the submarine part of the line was subject to a pressure of 280 feet.

When the water was first turned into the Peaks island system, it happened that the wells had been pumped nearly dry, the standpipe was empty and only the low parts of the system were getting water.

The head on the island end was equal to about 30 feet when we turned the supply from the city into the island system.

The meter showed a flow for the first few minutes at the rate of 600,000 gallons per 24 hours. The total length of this 6-inch line was 14,050 feet. The loss of head in the line when first turned on was 220 feet. This gives a value of C in the Williams and Hazen Tables of 125.

The 12,025 feet of wrought iron pipe was laid in 22 working days, an average of 546 feet per day. The best day's work was 1,160 feet in 10 hours. The poorest day's work was 150 feet.

The total cost of the entire 14,050 feet of main was $38,400. This included burying the cast iron pipe below frost, legal and engineering expenses and all overhead charges. The direct cost of the submarine part of the line was $26,125 for 12,025 feet, or $2.17 per lineal foot.

The cost of the pipe delivered in Portland was $1.56 per foot, leaving 61 cents per foot for the cost of the fittings and laying the pipe.

On Tuesday, November 2, 1920, there was a heavy storm with a high wind at Portland. A large steamer lying at anchor nearly a mile from the pipe line dragged her anchor about 2 o'clock in the morning until the anchor caught in the pipe line in the bottom of the channel in 30 feet of water. Where the anchor hit the pipe it bent the pipe to a 90-degree angle, broke a piece out of the top of the pipe at the bend and pulled the ends apart at the break until there was an opening of 100 feet between them.

The point of the break was nearly 3,000 feet from the Portland shore and this section of pipe was pulled off shore 9 feet, leaving an open space of this length where the galvanized and cast iron pipe joined. We filled this 9-foot space with a piece of cast iron pipe, and then attached an air compressor to the Portland end of the line. This machine was of a capacity to furnish 23 cubic feet of free air per minute. It required about two hours for the air to drive the water out of the open end of the pipe at the break. Then the air appeared at the surface, causing the water to appear to boil over an area 10 feet in diameter.

A diver was sent down to attach a line to the end of the pipe from which the air came, and find the other end. He found the pipe buried about 2½ feet in the soft mud, but was able to dig out a hole and get a line tied to the pipe. He could not find the other end of the break and it was necessary to carry the air compressor to Little

Diamond island and connect it to that end of the line. This was effective and showed the two ends to be 100 feet apart.

A line was then attached to this end of the pipe and an attempt was made to raise both ends to the surface and connect them together with three Moran joints in the line and then lower them to the bottom. They could be raised to the surface, but when lowered again invariably broke off 3 or 4 lengths back from the end.

Thus at every attempt the opening between the two ends became greater. We attached lines to the pipe 100 feet apart and tried working them up together but with no better success.

We determined that the suction of the mud on the pipe was very great and held the pipe with such force that it would break off or pull out at the first coupling out of the mud. Furthermore, the wind blew almost continuously at a rate that tossed the scows around and added to the strain on the pipe. The weather would not allow two successive days' work and the expense of the crew and boats was about $250 daily.

After working from November 3 to December 10, and spending $5,700, it was decided to wait until the winter weather was past before making any further attempts to repair the line.

It was shown, by examination of the pipe that broke off in attempting to raise it, that the pipe would bend a little before the joint would fail and it seemed that if the joint was a little stronger it would be possible to raise and lower the pipe as often as desired.

We accordingly designed and tested a method of strengthening the joints. We cut off a piece of 8-inch galvanized wrought iron pipe, 13 inches long. This was placed over the coupling between the two pieces of 6-inch wrought iron pipe and held in place by small wooden wedges. The space between the 6-inch pipe and coupling and the 8-inch sleeve was then filled with Leadite. The Leadite cooled in two or three minutes so that the collars and clay could be removed.

We then suspended the section of pipe at its two ends and piled pigs of lead on a platform suspended at the center by a rope on each side of the joint. It required 3,800 pounds of lead to exceed the elastic limit of the pipe metal and put a permanent bend in the pipe.

We then tried a joint, using Metallium for filling, and tested it by putting one end of the pipe under a building and raising the other end.

In both cases the pipe bent but the sleeve held the coupling without any sign of movement nor was there any sign of crushing either the Leadite or Metallium.

On April 12 of this year the wind moderated and we again took up the work where we left it in December. We completed the work in two weeks at a cost of $3,600, in the following manner:

We used two flat-bottomed scows, 20 x 40 feet, each equipped with gasoline winches, a tug boat and a crew of ten men.

The air compressor was attached to the Portland end of the pipe to force the water out and keep it out in order that it might be lighter to raise.

We used no diver, but dragged an anchor along the bottom until it caught the pipe. Then the pipe was raised a few feet from the bottom with the anchor, and a line was swept under it and a slip knot tied and carried to the hoist. The pipe was then raised about ten feet more and another line swept under the pipe as far as possible toward where it emerged from the mud. The second scow then lifted a few feet on this line to loosen the suction of the mud, and another line swept still further back. This operation was repeated until the end of the pipe was up on the scow. The laying of pipe was immediately begun, each coupling being covered with an 8-inch sleeve and the space filled with Leadite.

The tide was low and little wind blowing, and beginning at the middle of the deep channel and moving toward Little Diamond island, we laid 200 feet of pipe and lowered it to the bottom before dark with a plug screwed into the end. The following day at low tide we raised the end from the bottom easily, as all the joints were then reinforced, and continued laying pipe.

This work was continued until the pipe was laid up to where the water was about 12 feet deep at low tide. The Little Diamond island end of the pipe was then raised and 100 feet of pipe removed, leaving the two ends five lengths of pipe apart. The two scows were then swung around end to end ranging along the line of the pipe with the pipe hanging at their sides. The five lengths of pipe necessary to complete the line were then placed in position with four Moran joints inserted to provide flexibility.

The next move was the lowering of the pipe and at the same time pulling it to one side, forming a slight curve in the line.

The air compressor showed the line to be tight, and the same day we began supplying water to Peaks island.

The work was carried on under the immediate supervision of Harry U. Fuller, of the Portland Water District.

June Building Operations

According to the F. W. Dodge Co.'s review of construction activities during June in 27 northern states, the contracts awarded amounted to $227,711,000, which was 6 per cent less than in May. Of this amount 33 per cent was for residential buildings, 22 per cent for public works and utilities, 7 per cent for business buildings, 10 per cent for educational building and 28 per cent for industrial buildings. The increased activity was notable in places where there was most labor trouble.

The total amount of contracts awarded from January 1 to June 1 amounted to $1,066,256,000, which is 9½ per cent greater than the average semi-annular total for at least five years. The largest amount of business was in New York state and the northern New Jersey district, which totaled $62,659,000; an increase of 8 per cent over May; the central west almost equaling it with $61,028,000, a decrease of 16 per cent from May.

PUBLIC WORKS.

Published Weekly
by
Public Works Journal Corporation
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba.$3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
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Notable Tunnel Construction

Liberty tunnels, described in this issue, are of especial interest to engineers and contractors on account of the requirements, design, conditions encountered, methods adopted and the remarkably rapid progress attained which constitutes, it is believed, a world's record for work of this character.

The tunnels, more than a mile long, are for an ultimate vehicular service of nearly 1,700 automobiles per hour, necessitating a ventilation system of different capacity and operation from any previously installed.

The excavation, without intermediate shafts, through a treacherous material that needed immediate and constant support, involved very heavy timbering for an unusually wide and high span that has been provided for by the novel expedient of using steel beam segments permanently enclosed in the concrete lining so as to form a recognized reinforcement in it, eliminate the perishable wood heretofore used for such purposes, and at the same time effect a very important economy both in excavating and in concreting.

The excavation of the entire cross section practically at a single face; a reduction of drilling by the use of channeling machines in the headings; the uninterrupted handling of the muck by a steam shovel constantly served by trains of empty and full cars on a double track service line to avoid loss of time; the delivery of concrete to the steel forms by a combination of dump car and pneumatic distribution; the installation of abundant high-class mechanical power equipment, and the development of a high degree of emulation and efficiency by rivalry among the workmen in the adjacent twin tunnels, are all important construction features which have made possible the establishment of a new high record of 620 cubic yards of muck excavated daily and 20 feet advance from two rock headings maintained for an uninterrupted period of more than three months. Such results need no comment and are themselves a high encomium of the zeal, ability, and co-operation of the engineers and contractors and for the selection and abundance of equipment installed.

Set-Back Lines for Highways

Highway traffic has, during the past few years, increased in both intensity and character until it now approaches, in each of these respects, the condition of city traffic a few years ago. With this development, the paving of highways is approximating more and more to that of city streets. Counties are using as paving material brick, sheet asphalt and even stone block, asphalt block and wood block.

In the matter of width, however, most of the highway pavements remain narrower than those found in city streets. With the relatively small amount of stopping along the side of the highway, it probably will not for years be necessary to provide a section of the pavement width for standing vehicles, since these can be drawn up along the shoulders, or on special paved areas where necessary. It is, however, becoming apparent that many of our highways are altogether too narrow for the moving traffic and must be widened, and foresighted engineers and other highway officials will make provision for this both in designing the cross-section and in the total width of the road right of way.

Definite action along this line has recently been taken in Pennsylvania, as told elsewhere in this issue, the legislature of that state having authorized the State Highway Commission to secure a width of 120 feet for its main highways wherever it seems that traffic in the future may make such width desirable. Except where the highways are passing through cities, the provision of the additional width necessary by securing strips of farm lands on one or both sides should not be very expensive; but should the matter be delayed until houses, barns and other buildings should be built along the present boundary line, the cost of widening might be greatly increased.

The principle is similar to that involved in the provision for set-back lines in city streets. It does not seem desirable to take over immediately the entire width, which in many cases is at least double that which can be used to advantage at present; in fact, it would probably be cheaper and secure better results should the farmers be allowed to occupy the surplus width as farm land until it is needed. It is the part of wisdom, however, to make some arrangement at once while it can be done at little expense, for securing the right to use this additional width whenever it may be found necessary.

Decision as to Paving Materials

According to a local paper, a new policy has been adopted for Newark, N. J., by the director of the Department of Streets and Public Improvements, this being that the selection of materials to be used in laying new pavements shall hereafter be made by the engineers of that department and not by the abutting property owners. It is stated that a law which has now ceased to be in force practically made it mandatory for the city to lay any material that might be petitioned for by owners of more than half of the abutting property on any block.

Several years back a great many cities followed this practice either through legal compulsion or for other reasons, but fortunately practically all have abandoned it. As the editor of the paper in question remarks: "The city engineers are best qualified to exercise such judgment."

Steel Bridge Burns Down

Fear of the destruction by fire of old wooden bridges is generally entertained by those responsible for them, but in the case of steel bridges, fire has not been so much feared. However, on July 8, a steel bridge at Pittsburgh was burned and two of the three spans completely destroyed. The combustible matter in this case was the creosoted wood block floor, the heat from which was so intense as to warp the steel trusses out of shape and cause them to drop into the river.

The bridge so destroyed was that known as the Thirteenth Street bridge across the Alleghany river from Pittsburgh to Alleghany. The falling trusses completely blocked traffic in the river. The bridge was an old one and the county engineers had recently been ordered by the government to rebuild it in connection with the building of the Lake Erie canal. The cause of the fire is not known but it was conjectured that it might have been caused by crossed electric wires, by sparks from a steamer passing beneath, or by a leak in the 12-inch gas main which was carried by the bridge.

Three years ago the Sixteenth Street bridge across the same river was destroyed by a spectacular fire.

The Hackensack River Pollution

That the Hackensack river is rapidly approaching the condition of the Passaic, owing to pollution by Hackensack, Jersey City and other communities, is a statement made by the State Board of Health of New Jersey in connection with its announcement made on July 9 that Hackensack must at once make preparations for treating the sewage which it now discharges into that river. Both Hackensack and Jersey City were ordered a number of years ago to stop emptying raw sewage into the Hackensack river, but during the world war the matter was dropped. Now, however, the State Board of Health has made renewed demands upon these cities and has notified them that no further extensions of the sewer systems will be permitted until provision is made for purifying the sewage.

Pennsylvania Anticipating Wider Highways

At the instance of the Pennsylvania State Highway Department the 1921 legislature has enacted legislation which will give the State Highway Department power to increase the width of important thoroughfares where they deem it necessary. The department for two years has been studying traffic conditions on thoroughfares leading to important municipalities of Pennsylvania and expects eventually to increase the width of many of these, although little if any actual work of this kind will be done immediately. Width will be established, however, in much the same way that municipalities establish building lines along undeveloped streets.

The department hopes by this procedure to save the enormous expenditure which will necessarily be entailed in widening arterial roadways after improvements have been completed. The department is looking ahead fifteen or twenty years and expects ultimately to widen a number of the arterial thoroughfares to the 120 feet of width which the legislature has authorized.

It is anticipated that eventually it will be necessary to build thoroughfares skirting the larger municipalities and wide enough to accommodate several streams of traffic going in each direction. "Within a few years it will be unwise to send heavy trans-Pennsylvania traffic into Philadelphia and Pittsburgh, for example, inasmuch as addition of this traffic will add to the congestion of the downtown districts. Consequently wide roads must be provided around the larger cities so that traffic may be accommodated."

F. B. Crocker

Professor F. B. Crocker, electrical engineer, founder and head of the School of Eletcrical Engineering at Columbia University, died at his home in New York July 9. Professor Crocker was one of the pioneers of the electrical industry, to which his most conspicuous contribution was the commercial motor, first put into use in 1886. He was one of the founders of the C. & C. Company, and of the Crocker-Wheeler Company. He was interested in the standardization ot electrical equipment throughout the world and in this interest was one of the two American delegates to the International Electro-Technical Commission in London. During the war he was advisor to the members of the Naval Consulting Board.

$252,000,000 Great Lakes-St. Lawrence Ship Canal Recommended

Colonel W. P. Wooten, United States Army engineer, and W. A. Bowden, chief engineer for Canada, have submitted to the International Joint Commission at Washington their report recommending the construction of a 142-mile ship canal between the Great Lakes and the lower St. Lawrence river at an estimated cost of $252,728,200.

It will have a depth of 25 feet, with provision for increasing it to 30 feet, at an additional cost of $17,986,180. There will be nine locks, 33 miles of canals, 40½ miles of lake channel and 108 miles of river channel. Maintenance would cost $2,562,000 a year, the engineers estimate.

Provision is made for a power plant with 1,464,000 horsepower through a great dam at Long Sault Rapids, near Ogdensburg, N. Y., which would develop about 40 per cent of the potential power in the St. Lawrence river.

Road Construction Plant*

By B. H. Piepmeier†

Several small plants preferable to one large one. Transportation of aggregate and concrete. Use of pneumatic-tired trucks. Railroad equipment.

Successful road work offers more possibilities for different types of plants than perhaps any other single line of building construction, and every section of road to be built is a field for intensive study and investigation by the engineer and contractor.

A successful road contractor in Illinois states: "No equipment should be purchased by a contractor unless he has sufficient work in view to enable him to practically pay for the equipment with a reasonable profit." Such a statement should in no way discourage the road contractor in equipping himself thoroughly to do economical road work, but should force him to make a more complete analysis of his job before he invests in a road-building plant.

SMALL DUPLICATE CONSTRUCTION UNITS ADVANTAGEOUS

In general, the building of a system of roads requires the installation of a number of small plants in preference to a few large plants. This has been particularly true in the past on account of (1) the contractor's inability to secure experienced and capable superintendents for handling large-plant operations; (2) railroad transportation falling short in the delivery of sufficient materials to keep large plants working efficiently; and (3) frequent breaking of the machinery required in large road-construction plants.

The small construction unit necessitates doing many operations by hand at somewhat greater expense than if done with machinery; however, when the final analysis is made, the small unit will show considerable efficiency on account of the possibility of its operating many times independently of any one particular machine out of service through breakdown.

Conditions existing during the past few years have made it impossible for the contractor with a large plant layout to show a fair profit. As soon as labor and transportation conditions become more stabilized, the large plant will show a much greater efficiency.

Contractors must give considerably more thought to the design of road plant so that its successful operation may not be wholly dependent upon one piece of machinery. Many successful road contractors realize already that to insure a constant and uniform output, it is economy in many instances to duplicate machines.

In many instances duplicating concrete mixers has prevented a complete shutdown of operations. The average road job may not always justify a duplication of the mechanical units, but where a large season's work is required, a serious investigation of the advantage of the duplicate units should be made.

TRANSPORTATION OF MATERIALS

The transportation problem in road building is one of the most important factors in the economical construction of roads. Consequently this part of the plant operation should be given a great deal of study. The transportation cost should not only be estimated on the basis of the ton-mile cost but the effect it may have on the cost of operation of the remainder of the construction plant should be taken into consideration. Hauling cost varies from 20 to 40 cents per ton-mile. In a season's work a saving, therefore, of but a few cents per ton-mile may amount to several thousand dollars. The actual hauling costs may be exceedingly low, yet if the delivery affects the maximum output of the remainder of the plant, the inefficiency should naturally be charged against transportation cost.

Inasmuch as most specifications now prohibit storing road materials upon the subgrade, the road contractor is compelled to provide for transportation in one of two ways. He must deliver materials from his material yard to the road by industrial railroad equipment or by truck. The industrial equipment, while expensive in first cost, will enable the contractor to complete his work with a minimum amount of trouble under normal conditions and regardless of weather, the average industrial equipment will insure a more uniform delivery of materials than any other unit that may be used. The chief objection to the industrial unit is that it is limited to road construction with grades ordinarily less than 4 per cent and a minimum number of railroad crossings. Further objection would be that the high initial cost demands a large mileage of roads be built each year in order to absorb the interest on the investment and the depreciation.

In recent years truck delivery has superseded team delivery, being more rapid and delivering material to a paving mixer or from a mixer direct to the road with less disturbance to the roadbed. Truck transportation of road materials is very flexible and therefore suited to more different sections of work than perhaps any other method of transportation. It is especially suited to the delivery of mixed concrete from a central plant to the road being improved, and to the delivery of proportioned batches direct to the paving mixer or to a point at which the batch boxes may be transferred to a short industrial line which in turn delivers them to the paving mixer.

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*Excerpt of paper presented at the spring meeting of the American Society of Mechanical Engineers.

†Engineer of Construction, State of Illinois, Division of Highways.

DELIVERY OF CONCRETE FROM CENTRAL MIXING PLANT

The delivery of mixed concrete from a central mixing plant direct to the job enables the contractor to centralize operations and in many instances to economize in plant and operating expenses. It would seem possible that unloading aggregate and cement from railroad cars, mixing the materials to the desired proportions and consistency and turning out a mixed concrete, could be standardized to such an extent that central plants could be simplified and made more economical in operation. It is hoped that the mechanical engineer and the equipment designer will assist in the design of a practical and economical central mixing plant unit.

Mixed concrete may be delivered by industrial equipment, provided the hauls are reasonably short and the equipment is designed for small loads with considerable speed in transportation. The small pneumatic-tired truck will usually prove the most efficient machine for delivery of mixed concrete, taking the individual batch of mixed concrete direct from the mixer to the road being improved in the least possible time.

USE OF THE PNEUMATIC-TIRED TRUCK

The pneumatic-tired truck is essential when speed is an important factor in delivery and where it is necessary to do considerable hauling over the subgrade. This truck will usually reduce the load on the subgrade to less than 125 lbs. per square inch of surface, and this pressure, even though frequently applied, does not seriously injure or displace a prepared subgrade having average conditions.

It is true that it is practically impossible to deliver materials over earth roads with trucks when the roads are muddy or during rainy periods. However, the road may be materially improved and the truck used practically the entire construction season if the road is constantly maintained by the use of the road drag and given an application of half a gallon of oil per square yard of surface early in the construction season.

The light pneumatic-tired truck may also be used for the delivery of proportioned batches of aggregates direct to the paving mixer on the road being improved. There are now on the market many types of batch boxes and dump bodies which permit the batches to be dumped directly into the skip of the paving mixer. This method has proved to be very satisfactory. It differs from the delivery of mixed concrete in that a paving mixer is used instead of the stationary building mixer, and most of the operations of the contractor are out where the road is actually being laid.

IMPROVEMENTS IN DESIGN OF EQUIPMENT DESIRABLE

The plant investment of the road contractor of to-day is entirely too expensive compared with the work accomplished during a single construction season or from one particular installation of a construction plant. From $60,000 to $100,000 worth of plant equipment is frequently set up to build less than ten miles of highway. This is equivalent to charging off $2500 to $3,000 for equipment against every mile of road built. It is doubtful whether there is any other building construction in which so much depreciation and interest on plant investment must be charged off on so small an amount of work.

Many of our road-building machines are being made larger, more cumbersome, and more expensive each year. The fact that road-building machinery is subjected to more severe use than perhaps any other machinery used in building construction has induced the manufacturer to add to his equipment each year to insure more rigid construction. Many machines, such as the concrete paving mixer, can undoubtedly be completely redesigned and a machine produced much smaller in size, to mix more concrete and be less cumbersome on the job.

If the mixer designer can produce a smaller machine having a greater output per hour of operation and so designed that the consistency of the concrete produced can be controlled by the operator instead of by some unsatisfactory mechanical means, the results will be a wonderful aid to the road-building industry.

IMPROVEMENT IN RAILROAD EQUIPMENT

Practically all road contractors now unload aggregates from open-top cars by means of clam shells. This method is not always the most economical, but the contractor is forced to use it as he cannot secure all hopper-bottom cars he might desire. On account of the large volume of road materials to be delivered by railroad cars, some type of car should be designed that would permit of more rapid unloading by more economical methods. If this is not done, it is hoped at least that open-top-car manufacturers will improve the design of their cars and make them so that they can be more easily unloaded with clam-shell equipment.

Many open-top cars are now designed with projecting angles, rivets, bolts, braces, timbers, etc., which interfere with the efficient operation of the clam shell. It is difficult to understand why railroad cars could not be designed so that the interior of the car would be perfectly smooth. In fact, it would be practicable and economical for all open-top cars to be built with a fillet having a radius of about 18 inches in the bottom angle at the ends of the car. The curved bottom angles would permit the cars to be emptied more rapidly and economically either with hand shovels or clam shells.

Further investigation should also be made ot the use of open-top removable batch boxes for railroad transportation of materials. While the substitution of standardized batch boxes for open-top cars would be a very radical departure from present equipment, the average construction plant could be designed to handle the boxes much more economically than the loose materials.

Mechanical Equipment of Baltimore Water Department*

By V. Bernard Siems†

Comparison of itemized costs of excavating for and laying 6-inch to 36-inch mains by hand and by aid of machinery. Includes depreciation charges on all equipment, overhead charges, costs per foot of pipe and of service, etc.

During the winter months trenching machines, cranes, backfillers, air compressors, etc., are removed to the storage yards and completely overhauled. This is done only when there is no work on which this machinery can be used. The smaller gasoline pumps, melting furnaces, ground thawers, etc., are usually overhauled in the field.

COMPARISON OF COSTS—HAND LABOR VS. HAND LABOR AIDED BY MACHINERY

Curve No. 1 of Fig. 2‡ shows the comparison of labor cost per foot of installation of water mains by manual labor and manual labor aided by trenching machine. Referring to the table accompanying this curve, it will be seen that the percentage of economy obtained using a trenching machine with hand labor varies from 22.2 to 57.4 per cent. This percentage of saving is largely due to the intelligent placing of the laborers. For example: With an average corps of 14 men working with a trenching machine in the installation of a 6-inch water main, two laborers work on the surface to remove the material falling from the traveling buckets, three laborers are used to prepare the trench for pipe laying, two caulkers and two laborers pour the lead and caulk the joints, four laborers backfill the trench and ram the material, and one laborer attends to the lead melting furnace and keeps the water main installation corps supplied with tools. Such an organization will permit constant operation of a trenching machine throughout the working day.

The labor costs shown on Curve No. 1 are average ones which include excavating and backfilling of trench, installation of the cast iron pipe and the overhead of the watchman and foreman. The standard dimensions of trench use by the Department are shown below Curve No. 1. From experience we have found that four feet of cover will prevent freezing and the pipe will not be affected by vibration caused by heavy motor vehicles.

Curve No. 2 of Fig. 2 shows the comparison of excavation cost per foot of installation of water main by manual labor and trenching machine aided by manual labor. The percentage of saving with the use of the trenching machine varies from 50 to 56.8 per cent. A trenching machine will excavate from 15 cubic yards an hour in 50 per cent rock and sandstone to 25 cubic yards an hour in loam, gravel and disintegrated rock.

Curve No. 3 of Fig. 3 shows the comparison of average number of feet of water main installed by a man a day by hand labor and by hand labor aided by trenching machine. The term "installed" includes the excavation for, installation and backfill of the water main. This curve shows the saving of time in the installation of water mains by the use of the trenching machine. Referring to the table above the curve you will see that the percentage of time saved varies from 33.3 to 80.0 per cent. For example, it will take a water pipe corps of fifteen men installing water mains without the use of a trenching machine ten days to excavate for, lay and backfill 300 feet of 20-inch main; whereas a pipe laying corps using a trench-

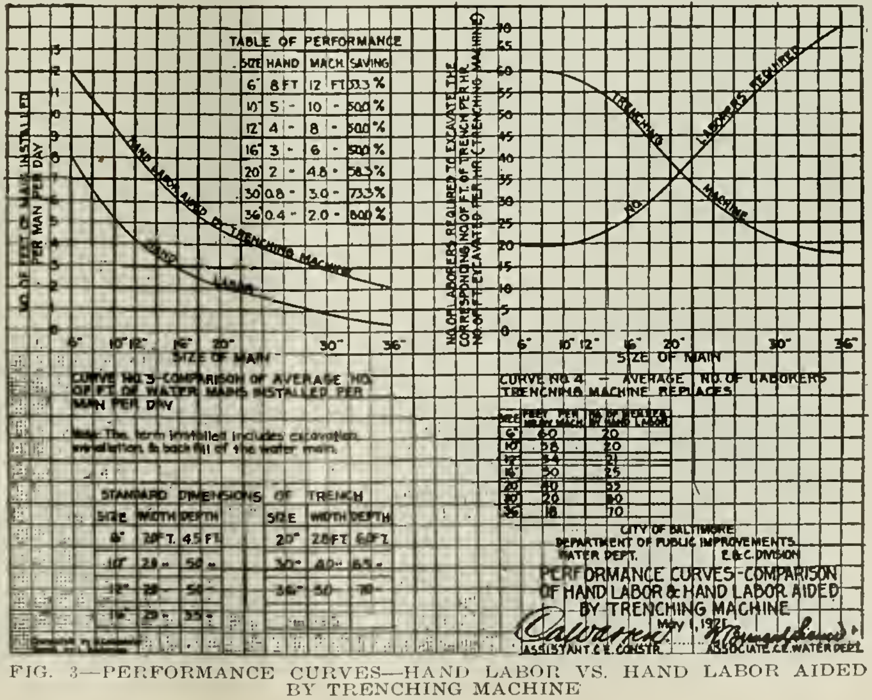

TABLE OF PERFORMANCE

SIZE	HAND	MACH.	SAVING
6"	8 FT	12 FT	33.3%
10"	5 -	10 -	50.0%
12"	4 -	8 -	50.0%
16"	3 -	6 -	50.0%
20"	2 -	4.8 -	58.3%
30"	0.8 -	3.0 -	73.3%
36"	0.4 -	2.0 -	80.0%

STANDARD DIMENSIONS OF TRENCH

SIZE	WIDTH	DEPTH	SIZE	WIDTH	DEPTH
6"	2.0 FT.	4.5 FT.	20"	2.8 FT.	6.0 FT.
10"	2.0 -	5.0 -	30"	4.0 -	6.5 -
12"	2.0 -	5.0 -	36"	5.0	7.0 -
16"	2.0 -	5.5 -			

SIZE	FEET PER HR. BY MACH.	NO. OF LABORERS BY HAND LABOR
6"	60	20
10"	58	20
12"	54	21
16"	50	25
20"	40	32
30"	20	60
36"	18	70

FIG. 3—PERFORMANCE CURVES—HAND LABOR VS. HAND LABOR AIDED BY TRENCHING MACHINE

ing machine to excavate the trench will complete the excavation, laying and backfilling of the 20-inch main in four days and two hours. Below this curve is a table of the standard dimensions of trench.

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*Continued from page 42. Paper before American Water Works Association.

†Associate Civil Engineer, Baltimore Water Department.

‡For Fig. 2, see p. 40 of last week's issue.

Curve No. 4 of Fig. 3 shows the average number of men the trenching machine replaces. This curve depicts the trenching machine as a labor-saving device. Upon examining the curve and the table, you will find that the number of men replaced by the use of the trenching machine varies from 20 to 70 men. For an example, take a 6-inch main: The number of linear feet of trench excavated in one hour by the trenching machine is 60, but it would require 20 men to excavate the 60 feet of trench in one hour. The same principle applies to the other size mains, the table giving the number of men replaced by the trenching machine for water mains of every size. This curve and table were prepared from the average of a number of installations of water mains of each size noted upon the diagram.

Curve No. 5 of Fig. 4 shows comparison of labor costs per foot of water mains between joints caulked by hand and those caulked with the use of pneumatic tools. The term "laying" refers only to the placing of the pipe in the trench and to the caulking of the joints. In the table of comparison of cost of caulking by hand and caulking with air hammers, you will notice that there is a loss varying from 37 to 53 per cent in favor of hand caulking, but this loss is overcome by the saving in time varying from 41.7 to 65.7 per cent by caulking with air hammers, thus resulting in a saving of 36.4 to 46.7 per cent on the completed work.

Curve No. 6 of Fig. 4 shows the comparison of backfill costs per foot of installation of water mains by hand labor and by backfiller. Noting the curve and tables, you will find that the percentage of saving varies from 33.3 to 52.5 per cent. Below the curve is a table of the standard dimensions of trench.

In order to determine the effective depth to which lead could be compressed in the caulking of cast iron water pipe joints, research work was initiated at the Municipal Laboratory in 1914. The results of these tests showed that lead, like other engineering materials, has a distinct characteristic curve. From this curve can be found the greatest possible compression, which never exceeds 2½ inches from the face of the bell, before the compressive molecular resistance of the lead itself equals or is greater than the tensile strength of the cast iron in the sides of the pipe bells. When such latter is the case, there immediately follows a bursting of the pipe bell; therefore, it was recommended that air compressors and pneumatic hammers operating under a long stroke and a moderate working pressure of 40 pounds per square inch be used on all the Department's caulking work.

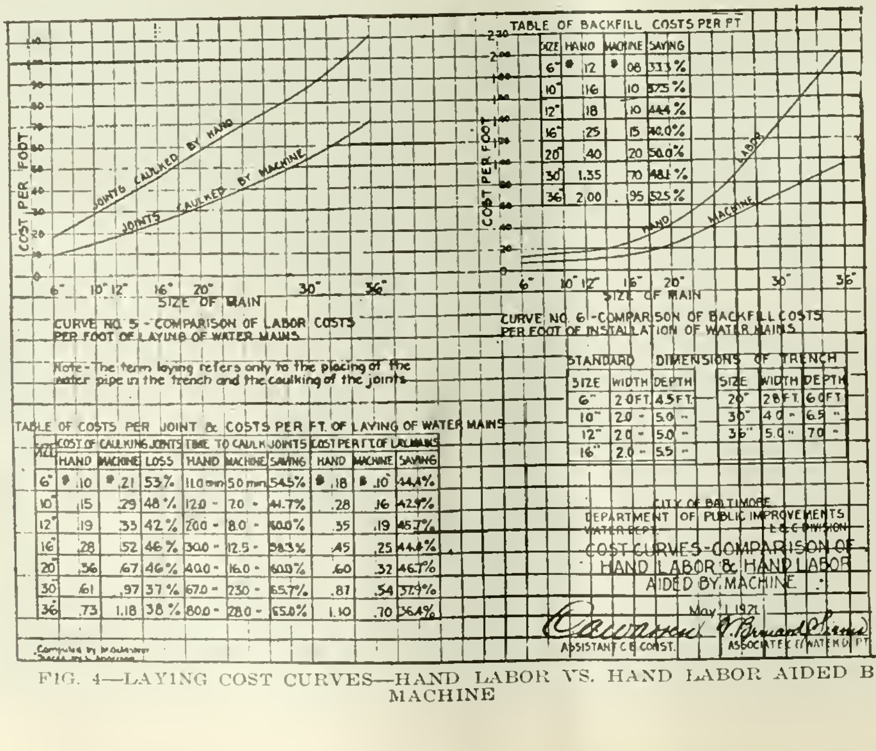
A comparison of cost of the laying of water mains by hand labor and hand labor aided by crane on pipe 30 inches and larger shows that it cost $.54 a foot to lay 30-inch pipe with hand labor aided by crane, and $.95 a foot to lay by hand labor alone, or a saving of 43.1 per cent by using the crane. On 36-inch pipe it cost $.70 a foot to lay with hand labor aided by crane, and $1.42 to lay with hand labor alone, or a saving of 50.7 per cent.

Table No. 1 shows the method of ascertaining the cost per hour of operating machinery. The explanation is given in the notes at bottom of the table.

Table No. 2 shows cost per foot of installation of water mains during part of years 1920 and 1921 by hand labor and by hand labor aided by trenching machine. The labor costs per foot (Column No. 2) shown in this table, include the cost of inserting small connections, such as 6-inch, 10-inch or 12-inch, and the installation of 6-inch, 10-inch and 12-inch valves at an average distance of 400 feet, which constitutes the length of a city block. The same applies to the material cost per foot of installation of 6-inch, 10-inch and 12-inch water mains (Column No. 4). The columns are explained by the notes at the bottom of the table.

Table No. 3 shows the hourly rate of pay and water works material cost. An explanation is given in the notes at bottom of the table.

Table No. 4 shows methods of ascertaining depreciation charges on standard tools and equipment of water pipe construction foremen. These computations are the result of investigation of



CURVE NO. 5 - COMPARISON OF LABOR COSTS PER FOOT OF LAYING OF WATER MAINS

Note - The term laying refers only to the placing of the water pipe in the trench and the caulking of the joints

TABLE OF COSTS PER JOINT & COSTS PER FT. OF LAYING OF WATER MAINS

SIZE	COST OF CAULKING JOINTS			TIME TO CAULK JOINTS			COST PER FT. OF LAY. MAINS		
	HAND	MACHINE	LOSS	HAND	MACHINE	SAVING	HAND	MACHINE	SAVING
6"	$ .10	$ .21	53%	11.0 min	5.0 min	54.5%	$ .18	$ .10	44.4%
10"	.15	.29	48%	12.0 -	7.0 -	41.7%	.28	.16	42.9%
12"	.19	.33	42%	20.0 -	8.0 -	60.0%	.35	.19	45.7%
16"	.28	.52	46%	30.0 -	12.5 -	58.3%	.45	.25	44.4%
20"	.36	.67	46%	40.0 -	16.0 -	60.0%	.60	.32	46.7%
30"	.61	.97	37%	67.0 -	23.0 -	65.7%	.87	.54	37.9%
36"	.73	1.18	38%	80.0 -	28.0 -	65.0%	1.10	.70	36.4%

TABLE OF BACKFILL COSTS PER FT

SIZE	HAND	MACHINE	SAVING
6"	$ .12	$ .08	33.3%
10"	.16	.10	37.5%
12"	.18	.10	44.4%
16"	.25	.15	40.0%
20"	.40	.20	50.0%
30"	1.35	.70	48.1%
36"	2.00	.95	52.5%

CURVE NO. 6 - COMPARISON OF BACKFILL COSTS PER FOOT OF INSTALLATION OF WATER MAINS

STANDARD DIMENSIONS OF TRENCH

SIZE	WIDTH	DEPTH	SIZE	WIDTH	DEPTH
6"	2.0 FT.	4.5 FT.	20"	2.8 FT.	6.0 FT.
10"	2.0 -	5.0 -	30"	4.0 -	6.5 -
12"	2.0 -	5.0 -	36"	5.0 -	7.0 -
16"	2.0 -	5.5 -			

CITY OF BALTIMORE
DEPARTMENT OF PUBLIC IMPROVEMENTS
WATER DEPT. L. & C. DIVISION
COST CURVES - COMPARISON OF HAND LABOR & HAND LABOR AIDED BY MACHINE
May 1, 1921

ASSISTANT C. E. CONST.
V. Bernard Siems
ASSOCIATE C. E. WATER DEPT.

FIG. 4—LAYING COST CURVES—HAND LABOR VS. HAND LABOR AIDED BY MACHINE

field conditions and are not assumptions. The depreciation charges are based upon a year of 300 working days.

Table No. 5 shows the methods of ascertaining the percentage of labor cost per foot of water main installations, covering loss and depreciation of tools. These results are explained by the notes.

Table No. 6 shows the method of ascertaining the overhead charge against each construction order. The Water Department consists primarily of the Engineering and Construction Division, Mechanical Division and Filtration Division. The Executive and Auditing Divisions are not considered separate as their entire operating cost is divided among the three above-mentioned divisions. The Construction Subdivision being one of three subdivisions of the Engineering and Construction Division, 11.11 per cent of the salaries of the Executive and Auditing Divisions of the Water Department, 33.33 per cent of the salaries of the executive and clerical forces of the Engineering and Construction Division, 100 per cent of the salaries of the engineers and clerks of the Construction Subdivision, the expenditure of the Bureau of Drafting for preparing Water Department plans and 11.11 per cent of the miscellaneous appropriations (buildings, equipment, automobiles, instruments, stationery, etc.) are charged to the Construction Subdivision as overhead. Dividing the total sum obtained as overhead by the total estimated expenditure of the Construction Subdivision, the percentage of overhead is obtained.

Tables Nos. 7 to 10 show the cost per foot of installation of water supply services, valves and fire hydrants, also standard dimensions of valve vaults. The costs per foot of installation of water supply services include tapping the main, insertion of the corporation, lead tail, lead lined

Table No. 2

Cost Per Foot of Installation of Water Mains Part of Years 1920 and 1921 by Hand Labor and Hand Labor Aided by Machinery

	Hand Labor						Hand Labor Aided by Machinery						
Size (1)	Labor cost per foot (2)	Miscellaneous cost per ft. (3)	Material cost per ft. (4)	Depreciation cost per ft. (5)	Overhead cost per ft. (6)	Total cost per foot (7)	Labor cost per foot (2)	Miscellaneous cost per ft. (3)	Material cost per ft. (4)	Depreciation cost per ft. (5)	Overhead cost per ft. (6)	Total cost per foot (7)	Condition of subsurface (8)
6 in.	$1.85	$0.10	$1.70	$0.19	$0.38	$4.22	$1.30	$0.10	$1.70	$0.13	$0.32	$3.55	Maximum
6 in.	0.90	0.10	1.70	0.09	0.28	3.07	0.70	0.10	1.70	0.07	0.26	2.83	Average
6 in.	0.55	0.10	1.70	0.06	0.24	2.65	0.40	0.10	1.70	0.04	0.22	2.46	Minimum
10 in. ...	2.60	0.13	2.60	0.26	0.56	6.15	1.80	0.13	2.60	0.18	0.47	5.18	Maximum
10 in. ...	1.30	0.13	2.60	0.13	0.42	4.58	0.90	0.13	2.60	0.09	0.37	4.09	Average
10 in. ...	0.90	0.13	2.60	0.09	0.37	4.09	0.55	0.13	2.60	0.06	0.33	3.67	Minimum
12 in. ...	2.85	0.15	3.25	0.29	0.65	7.19	2.10	0.15	3.25	0.21	0.57	6.28	Maximum
12 in. ...	1.90	0.15	3.25	0.19	0.55	6.04	1.00	0.15	3.25	0.10	0.45	4.95	Average
12 in. ...	1.10	0.15	3.25	0.11	0.46	5.07	.60	0.15	3.25	0.06	0.41	4.47	Minimum
16 in. ...	4.10	0.22	5.20	0.41	0.99	10.92	2.50	0.22	5.20	0.25	0.82	8.99	Maximum
16 in. ...	2.80	0.22	5.20	0.28	0.85	9.35	1.50	0.22	5.20	0.15	0.71	7.78	Average
16 in. ...	1.95	0.22	5.20	0.20	0.76	8.33	1.10	0.22	5.20	0.11	0.66	7.29	Minimum
20 in. ...	7.40	0.35	7.75	0.74	1.62	17.86	4.10	0.35	7.75	0.41	1.26	13.87	Maximum
20 in. ...	3.95	0.35	7.75	0.40	1.25	13.70	2.20	0.35	7.75	0.22	1.05	11.57	Average
20 in. ...	2.80	0.35	7.75	0.28	1.12	12.30	1.90	0.35	7.75	0.19	1.02	11.21	Minimum
30 in. ...	12.35	0.80	15.30	1.24	2.97	32.66	9.00	0.80	15.30	0.90	2.60	28.60	Maximum
30 in. ...	9.40	0.80	15.30	0.94	2.64	29.08	4.00	0.80	15.30	0.40	2.05	22.55	Average
30 in. ...	5.20	0.80	15.30	0.52	2.18	24.00	3.40	0.80	15.30	0.34	1.98	21.82	Minimum
36 in. ...	16.85	0.95	19.20	1.69	3.87	42.56	12.20	0.95	19.20	1.22	3.36	36.93	Maximum
36 in. ...	12.00	0.95	19.20	1.20	3.34	36.69	5.80	0.95	19.20	0.58	2.65	29.18	Average
36 in. ...	9.85	0.95	19.20	0.99	3.10	34.09	5.10	0.95	19.20	0.51	2.58	28.34	Minimum

Columns: No. 1—Water mains and fittings. No. 2—Excavating, laying, backfilling; overhead of foremen and watchmen. No. 3—Hauling pipe, fittings, etc., investigating subsurface obstructions; operating valves. No. 4—Cost of cast iron pipe, fittings, rope, timbers, etc. No. 5—10 per cent of labor cost (see table No. 5). No. 6—10 per cent of summary of columns 2, 3, 4 and 5. No. 7—Total cost of installation. No. 8—Material excavated and subsurface obstructions encountered. MAXIMUM (a) Material excavated—50 per cent sandstone, granite or other rock, or (b) subsurface obstructions of such a nature that (a) would apply as to time and cost of work (industrial sections). AVERAGE—(a) Material excavated—loam, clay, gravel and deteriorated rock, or (b) subsurface obstructions of such a nature that (a) would apply as to time and cost of work (industrial and business sections). MINIMUM—(a) Material excavated—sand, loam and gravel, or (b) subsurface obstructions of such a nature as found in typical residential public highways.

Table No. 3

	Hourly Rate of Pay		
Title	Max.	Aver.	Min.
Water pipe Constr. Foreman	0.72	0.63	0.56
Labor foreman	0.54	0.54	0.54
Handy man	0.55	0.525	0.50
Pipe caulker	0.50	0.50	0.50
Special laborer	0.45	0.425	0.40
Night watchman	0.38	0.38	0.38

Material Costs					
Material	Unit price	Material	Unit price	Material	Unit Price
Class B c. i. pipe	$71.00 per ton	¾-in. wrought iron lead lined pipe	$0.22 per ft.	¾-in. lead tail	$2.46
Cast iron fittings	$140.00 per ton	1-in. "	$0.30 per ft.	1-in. lead tail	$3.30
Coal oil	$0.115 per gal.	2-in. "	$0.70 per. ft.	2-in. lead tail	$12.49
Gasoline	$0.235 per gal.	¾-in. corporat'n	$1.34	¾-in. curb stops	$1.18
Lead	$0.55 per lb.	1-in. "	$1.45	1-in. curb stops	$1.80
Lumber	$0.045 board ft.	2-in. "	$7.04	2-in. curb stops	$7.34
Packing rope	$0.09 per lb.	3 ft. curb stop box	$1.50	5 ft. curb stop box	$1.95

Note: $71.00 per ton for class "B" cast iron pipe refers to unit purchase price in year 1920. Present unit price for class "B" cast iron pipe is $61.00 per ton. Other unit prices refer to purchases made in 1921.

pipe, curb stop and curb stop box. The installation of cast iron water supply services includes the insertion of the sleeve and three-way, cast iron pipe, valve and roadway box. The cost of installation of valves includes the cost of the valve, lead blocking, packing, rope, etc. The cost of erection of the vault for valve includes the labor, material, depreciation and overhead. The cost of the installation of fire hydrants includes the cost of the insertion of three-way and sleeve, cast iron pipe, valve and fire hydrant.

LOCATION OF SUBSURFACE STRUCTURES IN PUBLIC HIGHWAYS

Fig. No. 5 shows sections of public highways of various widths, suggesting locations of subsurface structures so as to permit the use of trenching machines in most all the public highways.

These sections also show the possibility of placing public utilities structures in a definite location so as to safeguard against interrup-

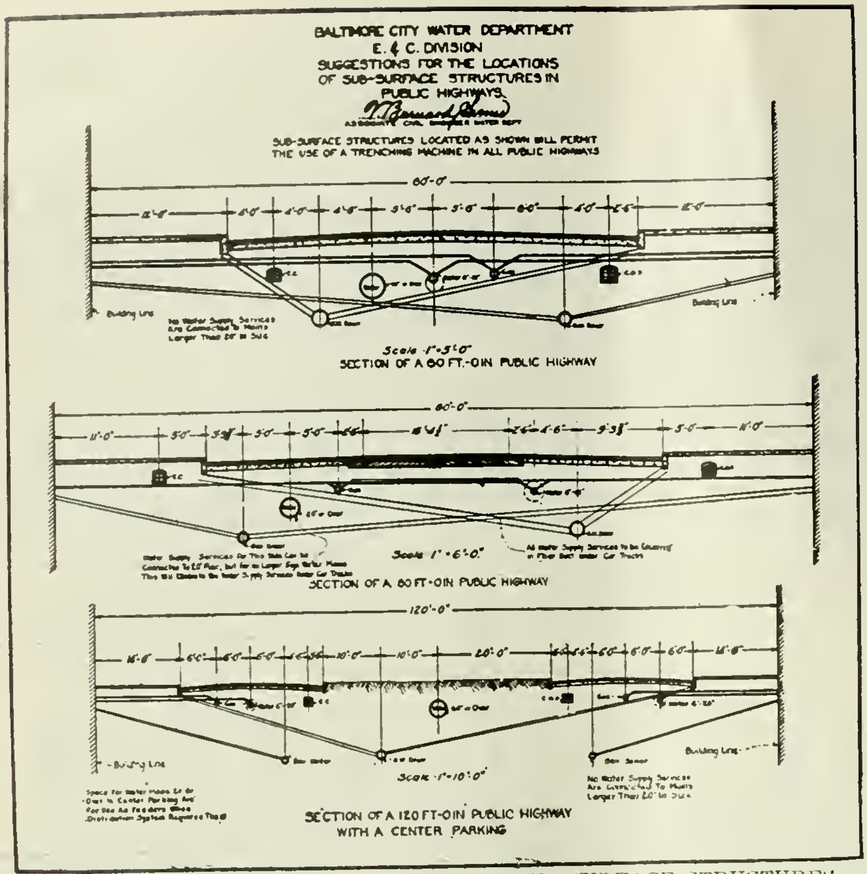

BALTIMORE CITY WATER DEPARTMENT
E. & C. DIVISION
SUGGESTIONS FOR THE LOCATIONS OF SUB-SURFACE STRUCTURES IN PUBLIC HIGHWAYS.
ASSOCIATE CIVIL ENGINEER WATER DEPT
SUB-SURFACE STRUCTURES LOCATED AS SHOWN WILL PERMIT THE USE OF A TRENCHING MACHINE IN ALL PUBLIC HIGHWAYS
60'-0"
Building Line
Scale 1"=5'-0"
SECTION OF A 60 FT.-0 IN PUBLIC HIGHWAY
60'-0"
Scale 1"=6'-0"
SECTION OF A 60 FT-0 IN PUBLIC HIGHWAY
120'-0"
Building Line
Scale 1"=10'-0"
SECTION OF A 120 FT-0 IN PUBLIC HIGHWAY WITH A CENTER PARKING

FIG. 5—SUGGESTIONS FOR LOCATIONS OF SUB-SURFACE STRUCTURES

Table No. 4

Method of ascertaining depreciation charges on standard tools equipment of a water pipe construction foreman—Construction sub-division.

Description of a Water Pipe Const. Foreman's Equipment for an Average Size Corps of 14 Men	Probable life of Equipm't	Original cost of Equipm't	Depreciation Cost per day of Equipm't
1 Watchman's House	5 years	$255.00	$0.17
1 First-Aid Cab. (compl.)	3 months	15.00	0.20
1 Oil stove	1 year	6.00	0.02
2 Tool boxes	2 years	50.00	0.08
15 Picks	6 months	17.00	0.11
15 Long-handle shovels	6 months	39.75	0.26
4 Mattocks	6 months	8.00	0.05
2 Digging Bars	6 months	6.80	0.05
2 Steel bars	6 months	7.60	0.05
6 Wall points	3 months	12.00	0.16
10 Ditch jacks	1 year	50.00	0.17
4 Sledge hammers	3 months	8.00	0.10
4½ lb. hammers	3 months	5.00	0.07
1 Adz	6 months	2.00	0.01
1 Axe	6 months	2.00	0.01
4 Gallous keys	1 year	12.40	0.04
2 Socket keys	1 year	6.00	0.02
4 Hydrant keys	1 year	6.32	0.02
2 N. S. Hydrant keys	1 year	3.00	0.01
2 Corporation keys	1 year	4.50	0.02
2 Curb stop keys	1 year	2.00	0.01
12 Handle diamond point tools	3 months	12.10	0.16
6 Finger diamond point tools	3 months	9.00	0.12
5 Pipe cutters (handle)	3 months	6.25	0.08
6 Pipe cutters	3 months	10.50	0.14
5 Breaking-out chisels	3 months	7.50	0.10
3 Long chisels	3 months	4.80	0.07
10 Roping tools	9 months	11.00	0.05
3 Lead runners	6 months	45.00	0.30
1 Hauck lead melting furnace	2 years	88.35	0.15
3 9-in. ladles	1 year	9.00	0.03
1 6-in. ladle	1 year	2.00	0.01
12 handle caulking tools	3 months	12.00	0.16
3 sets finger caulk. tools	6 months	36.00	0.24
1¾ in. Mueller tapping machine	1 year	180.00	0.60
3 Saddles	1 year	9.00	0.03
1 Vise	1 year	5.50	0.02
2 3-wheel pipe cutters	9 months	24.00	0.12
1 Set stocks and dies	6 months	15.00	0.10
1 Ditch ratchet (comp.)	1 year	25.00	0.08
3 Monkey wrenches	1 year	8.00	0.03
4 Stillson wrenches	1 year	11.32	0.04
2 Rasps	6 months	2.50	0.02
1 Oiler	2 years	2.50	0.01
3 Rammers	2 years	7.00	0.01
1 Wood chisel	1 year	5.80	0.02
1 8-in. single block	6 months	3.40	0.02
1 8-in. double block	6 months	6.00	0.04
1 Hand saw	6 months	2.50	0.02
1 cross-cut saw	6 months	8.35	0.06
1 Chain	6 months	2.40	0.02
1 Street broom	1 year	1.00	0.01
3 Buckets	3 months	1.95	0.02
10 Pairs rubber boots	6 months	50.00	0.33
15 Slickers	1 year	75.00	0.25
15 Standards	1 year	30.15	0.10
1 50-ft. tape	6 months	3.00	0.02
10 Red flags	3 months	5.00	0.07
		Total	$5.29

From the life and original cost, the depreciation for each water pipe construction foreman's equipment is **$5.29** per day.

Note—Method of ascertaining the percentage of labor cost to apply to installation of water mains to cover the depreciation and loss of tools is shown on Table 5.

Table No. 8

Cost of Installation of Valves in (66-ft. public highway)

HAND LABOR

Size	Labor cost (1)	Material cost (2)	Depreciation cost (3)	Overhead Cost (4)	Cost of erection of vault	Total Cost (5)
6 in.	$5.30	$31.20	$0.53	$3.70		$40.73
10 in.	6.20	74.95	0.62	8.18		89.95
12 in.	6.70	92.80	0.67	10.02		110.19
16 in.	8.20	131.86	0.82	14.09	$126.59	281.56
20 in.	15.20	281.95	1.52	28.87	169.18	497.72
30 in.	32.10	462.14	3.21	49.75	233.08	780.28
36 in.	41.10	1430.10	4.11	147.53	317.68	1940.52

tion of service. Should municipalities adopt a standard of location for subsurface structures in public highways, especially in the newer sections of cities, it will have a tendency to decrease the construction and maintenance costs.

The large amount of work completed by the Water Department has been due to the fact that Wm. A. Megraw, water engineer, has encouraged the purchase of machinery for use in the construction of water mains, which procedure was inaugurated Walter E. Lee, former incumbent.

Due acknowledgment is given herewith to the work of C. A. Warren, assistant civil engineer in charge of the Construction Subdivision of the Engineering and Construction Division, and to his assistant, Maurice Goldstein, junior civil engineer, for the cost data furnished.

Table No. 6
Method of Ascertaining Overhead Charge Against Each Const. Order by the Construction Sub-division of E. & C. Division

Water dept. divisions & sub-divisions	Salaries of employees	P. C. of salaries charged against const. order	Salaries charged as overhead
Executive division water dept.	$16,100.00	11.11%	$1,788.88
Auditing division water dept.	16,800.00	11.11%	1,866.66
Executive subdiv., E. & C. div.	10,400.00	33.33%	3,466.66
Clerical subdiv. E. & C. div.	21,870.00	33.33%	7,290.00
Construction subdiv., E. & C. div.			
1 Asst. civil engr. construction	2,500.00	100.00%	2,500.00
2 Junior civil engineers	3,300.00	100.00%	3,300.00
3 Engineering aids	3,550.00	100.00%	3,550.00
1 Junior clerk (cost acct. work)	1,200.00	100.00%	1,200.00
1 Timekeeper	1,400.00	100.00%	1,400.00
E. & C. Division drafting at Bureau of Drafting	8,137.80	100.00%	8,137.80
Total Salaries Charged as overhead			$34,500.00
Water dept., miscel. approps. (bldgs., equipment, autos, instruments, stationery, etc.)	94,500.00	11.11%	$10,500.00
Grand Total of Salaries and Miscellaneous Appropriations Charged as Overhead			$45,000.00

Total expenditures of Construction Subdivision of E. & C. Division is estimated at $450,000 for year 1921.

Percentage of Overhead — $\frac{\$45{,}000}{\$450{,}000} = 10\%$

Table No. 5
Method of Ascertaining Per Cent Labor Cost Per Foot Water Mains Installed Covering Loss and Depreciation of Tools.

Size (1)	No. of men in water pipe const. corps. (2)	No. of ft. water main installed by corps per day (3)	Deprec. cost of tools per ft. of water mains installed (4a)	(4b)	Aver. cost per ft. of water mns. covering loss & breakage of tools (5)	Labor cost per ft. of water mains installed (6)	P. C. of labor cost per ft. of water mains installation applied to deprec. and loss of tools (7a)	(7b)
6 in.	14	75	$\frac{\$5.29}{75}$	$0.07	$0.02	$0.90	$\frac{\$0.09}{\$0.90}$	10%
10 in.	14	60	$\frac{\$5.29}{60}$	$0.09	$0.03	$1.30	$\frac{\$0.12}{\$1.30}$	9.2%
16 in.	14	30	$\frac{\$5.29}{30}$	$0.18	$0.04	$2.80	$\frac{\$0.22}{\$2.80}$	7.9%
20 in.	14	25	$\frac{\$5.29}{25}$	$0.21	$0.05	$3.95	$\frac{\$0.26}{\$3.95}$	6.7%
30 in.	14	10	$\frac{\$5.29}{10}$	$0.53	$0.07	$9.40	$\frac{\$0.60}{\$9.40}$	6.3%

Column 1—Size of cast iron pipe class "B" and necessary cast iron fittings for a typical public highway. Column 2—Average sized water pipe construction corps. Column 3—Average number of feet of water mains installed by a corps of size noted in Column 2. Column 4a—Fraction equals total depreciation of tools divided by number of feet of water mains installed per day. (See Table 4 for depreciation on each tool.) Column 4b—Quotient of column 4a equals depreciation cost of tools per foot of water mains installed. Column 5—Loss and breakage of petty tools such as chisels, small caulking tools, etc. Column 6—Labor cost per foot of water mains installed. "Installation" includes excavation, laying and backfilling. Column 7a—Fraction equals depreciation cost plus breakage and loss of petty tools divided by labor cost per foot (Column 4b plus 5 divided by 6). Column 7b—Percentage of total labor cost that covers the depreciation, loss and breakage of tools.

Table No. 7
Costs per foot of installation of water supply services in (66-foot public highway)

Size	HAND LABOR Labor cost per foot (1)	Material cost per foot (2)	Depreciation per foot (3)	Overhead cost per foot (4)	Total cost per foot (5)
¾-in. wrought iron lead lined pipe	$0.27	$0.66	$0.03	$0.10	$1.06
1-in. wrought iron lead lined pipe	0.30	0.78	0.03	0.11	1.22
2-in. wrought iron lead lined pipe	0.40	2.19	0.04	0.26	2.89
3-in. Class B c. i. pipe	0.45	2.15	0.05	0.27	2.92
4-in. Class B c. i. pipe	0.50	2.57	0.05	0.31	3.43

Note: Column 1—Excavation, laying, backfilling: overhead of foremen and watchmen. Column 2—Cost of cast iron pipe, fittings, lead, rope, timber, etc. Column 3—10 per cent of the labor cost (tools and equipment, see Table No. 5). Column 4—10 per cent of the summary of Columns 1, 2 and 3. Column 5—Total cost of installation.

Table No. 9
Cost of Installation of the Hydrants in (66-ft. Public Highway)

Size	HAND LABOR Labor Cost (1)	Material cost (2)	Depreciation Cost (3)	Overhead Cost (4)	Total cost (5)
6 in.	$47.65	$106.75	$4.77	$15.92	$175.09

Table No. 10
Standard Vaults for Valves

Size of Valves	Size of Vaults Length Inside	Inside Width	Average Depth	Thickness of Brick walls	Thickness of Rein-forced Concrete slab	Diameter of Manhole frame
16 in.	4.5 ft.	4.5 ft.	5.9 ft.	9 in.	6 in.	24 in.
20 in.	8.0 ft.	4.5 ft.	6.0 ft.	9 in.	6 in.	24 in.
30 in.	11.0 ft.	5.5 ft.	6.5 ft.	13 in.	7 in.	30 in.
36 in.	13.0 ft.	6.0 ft.	7.0 ft.	13 in.	7 in.	30 in.

Construction Questions Answered

How to Handle and Erect Bridge Girders Without Special Equipment—I

Transporting to site and erecting by protrusion.

Steel bridge spans up to a length of about 60 feet are almost always shipped to the site with the trusses or girders complete in single pieces or in two sections requiring only to be riveted together at the site. This is also frequently the case for spans up to 80 or 90 feet and under special circumstances may be the case for spans of 120 or 130 feet in length. Many of these spans are plate girders with solid steel webs to 10 feet in depth. Others are riveted trusses with the depth usually varying from 6 to 15 feet, which are also considered as girder spans. In any event they are completely fabricated at the bridge shops, where they are loaded on cars for shipment.

ERECTION BY FABRICATORS

Transportation, handling and erecting are separate matters that the bridge manufacturer may undertake, but which he does not generally wish to do, so that the erection of a bridge is often unduly expensive or slow if left to the convenience of the fabricator. A few contractors make a specialty of it and are provided with the necessary equipment for handling ordinary work.

Where competition can be secured or the site is not too remote or too much restricted by uncertain traffic problems and other uncertain conditions, it is generally better to have spans of more than 30 or 40 feet erected by the bridge company or a regular erector; but if this is not practicable, or if it appears that their charges are unduly high, it is generally possible to handle any girder spans, excepting, perhaps, very heavy ones for railroad traffic, by simple appliances within the reach of any general contractor and that do not involve a heavy special outlay.

ERECTION BY GENERAL CONTRACTOR

Highway spans of not more than 40 feet in length, for rural locations, may have a total steel weight up to 10 or 12 tons; their girders may weigh from 1 to 5 tons each and be from 2 to 5 feet in depth, and are riveted up complete before shipment.

For longer spans the girders will always be shipped separately, will have depths up to 10 or 15 feet and may have weights up to 20 or 30 tons each. In any event the spans can be unloaded and hauled to the site with the ordinary railroad facilities and by the use of locomotive cranes, derricks, gantries and jacking, cribbing and skidding operations as described in the article on highway bridge constructon, page 393, May 7th.

If the bridge is a highway span over a railroad track it can usually be delivered by the railroad and unloaded from it at low grade at some point very near the site and afterwards moved on rollers to the abutments and hoisted up to position without interfering with train service.

HAULING TO SITE

If the site is remote from the railroad the girders will have to be hauled, usually on special trucks or pairs of trucks, often suspended from the axles of special large wheel trucks so as to just clear the surface of the ground. Very deep girders are likely to be too large for clearance between the wheels and are loaded on bolsters on top of the trucks as shown in the picture of an 86-foot girder for a bridge 50 feet wide at Torresdale avenue over Frankford creek, Philadelphia. These girders weighed 39 tons each and were loaded on pairs of trucks with wide flange steel wheels and drawn by a tractor. They were hauled and erected by the fabricator, the American Bridge Company, that unloaded the heavy cross girders with a locomotive derrick.

HANDLING A 40-TON PAIR OF GIRDERS

Some very interesting and ingenious work was done in the erection of the Wabash River bridge by a simple method and the use of equipment much too light to handle the bridge outright. This bridge has four spans each with two 20-ton plate girders 95 feet long and 8 feet deep. After being riveted up complete at the bridge shop, the girders of each span were temporarily clamped together in pairs 4 feet 8½ inches apart center to center.

The pairs of girders, weighing 80,000 pounds or more, were lifted by two 6,000-pound pneumatic hoists, one at each end, suspended from the roof trusses of the shop (this could have been accomplished in the field by substituting tackles or jackscrews for the hoists). The girders were balanced on cribwork near the middle, then one end was hoisted into an inclined position by one air hoist, then a second cribwork was built under them just beyond the center and the other pneumatic hoist was operated and easily rocked them over the new cribwork, raising that end the highest, the first cribwork was built up higher, and the girders rocked back on it, and so on alternately until both piles of blocking, one each side of the center, were carried up to support the girder higher than the floor of

UNLOADING BRIDGE GIRDERS BY LOCOMOTIVE CRANE AT SITE

HAULING GIRDER FOR TORRESDALE AVENUE BRIDGE

the flat cars which were run under both ends and to which the girders were lowered for shipment.

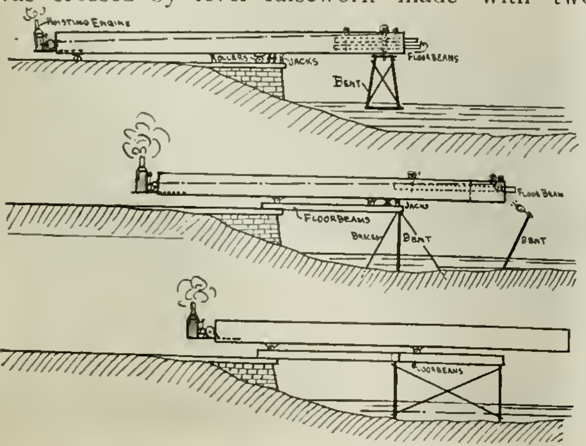
TRANSPORTING GIRDERS WITHOUT TRACKS

The railroad delivered these girders at a point half a mile from the bridge site. Here they were balanced on center fulcrum as before, and the ends were alternately lifted with light jackscrews so as to receive under the bottom flanges two pairs of rollers as shown in the diagram with 19-inch wheels having 9-inch faces and attached to bolted oak frames that had conections on top to hold them in place on the lower flanges of the girders. The wheels were built of oak blocks set between the flanges of a cast iron hub and bound with a steel tire ⅜ inch thick.

The rollers were placed about 35 feet from the ends of the girders. A platform was built on the ends of the girders and an ordinary hoisting engine mounted there, then a track of heavy timbers was built from the surface of the ground to the level of the car floor and supported by solid timber blocks. The girders were lowered down this track by hauling on a tackle anchored in advance and simultaneously slacking off on a preventer tackle in the rear.

TURNING THE GIRDERS

After reaching the ground level the girders were revolved 90 degrees on a turntable made with a 7-foot ring of ⅞-inch square steel, well greased and taking bearing on the lower flanges of the girders after the trucks were temporarily removed. Then the trucks were replaced and the bridge was hauled to the site by the hoisting engine and tackle, which was anchored to successive telegraph poles in advance of the girders. Slight curves were made easily and a five per cent grade down to the bridge was crossed by level falsework made with two lengths of floorbeams. Two-inch planks of green hard maple 10 inches wide were used for tracks.



ERECTING WABASH BRIDGE GIRDERS IN SPANS, BY PROTRUSION OVER FALSEWORK BENTS

ERECTING BY PROTRUSION WITH INTERMEDIATE SUPPORTS

On arrival at the bridge site the pair of girders was rolled out until it projected about a third of its length over the abutment. It was jacked up and supported by cribwork and blocking on top of the abutment, and from the end was suspended and set in place one framed bent of falsework.

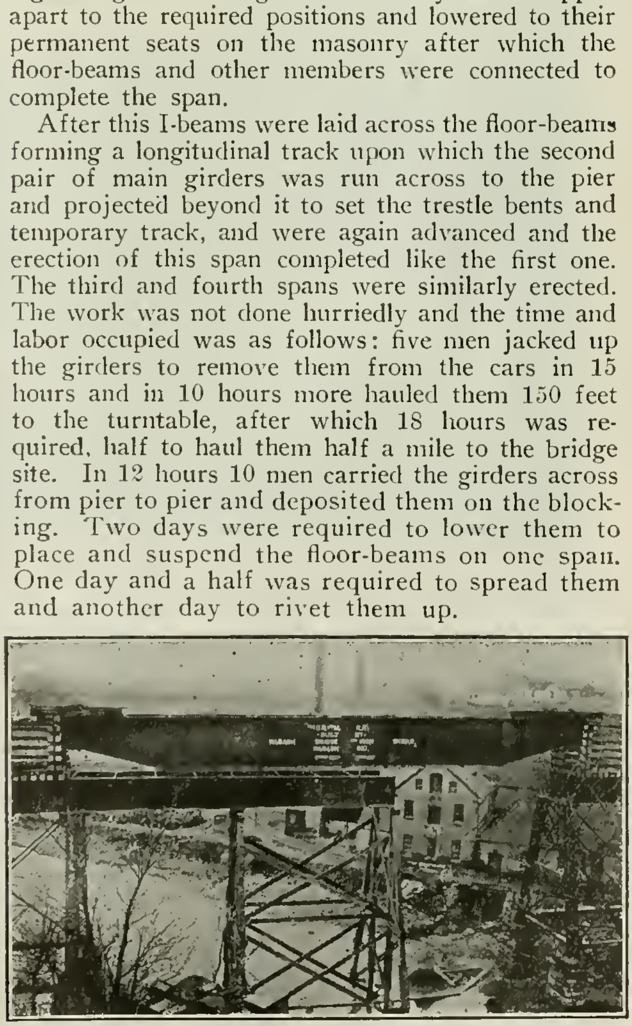
Two pairs of floor-beam girders had been suspended between the main girders near their upper edge and one pair of these was now lowered to bearing on them with their trucks and run forward another third of their total length until they again projected a third beyond the support.

They were again jacked up and another trestle bent set from the forward end and the remaining pair of floor-beams lowered into position in advance of the first ones upon the two trestle bents. The track was continued upon them and the main girders again lowered upon their trucks and advanced, this time being enabled to roll forward until the front end reached the pier.

LOWERING TO POSITION

They were then lowered to rest on cribwork at each end and the floor-beams and trestle bents removed from underneath. Then they were jacked down on greased skidrails and the clamps connecting the girders being removed they were slipped apart to the required positions and lowered to their permanent seats on the masonry after which the floor-beams and other members were connected to complete the span.

After this I-beams were laid across the floor-beams forming a longitudinal track upon which the second pair of main girders was run across to the pier and projected beyond it to set the trestle bents and temporary track, and were again advanced and the erection of this span completed like the first one. The third and fourth spans were similarly erected. The work was not done hurriedly and the time and labor occupied was as follows: five men jacked up the girders to remove them from the cars in 15 hours and in 10 hours more hauled them 150 feet to the turntable, after which 18 hours was required, half to haul them half a mile to the bridge site. In 12 hours 10 men carried the girders across from pier to pier and deposited them on the blocking. Two days were required to lower them to place and suspend the floor-beams on one span. One day and a half was required to spread them and another day to rivet them up.



ERECTING WABASH BRIDGE GIRDERS IN PAIRS BY PROTRUSION

NEWS OF THE SOCIETIES

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference. Hotel La Salle, Chicago, Ill.

Aug. 23-25—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS Annual meeting. Detroit, Mich. Secretary, Emmet P. Griffin, Superintendent of Park, East St. Louis, Ill.

Aug. 30-Sept. 1—MICHIGAN STATE GOOD ROADS ASSOCIATION. Annual meeting. Flint, Mich.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 5-7—SOCIETY OF INDUSTRIAL ENGINEERS. National convention. Springfield, Mass.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F, Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

ENGINEERS' ASSOCIATION OF FAIRFIELD COUNTY, CONN.

At its fifth annual dinner on June 2, this association was addressed by Nelson P. Lewis, formerly chief engineer of the Board of Estimate and Apportionment, New York, on "Scientific City Planning," F. B. Bartram, president of the Stamford, Conn., Chamber of Commerce, on "Stamford's Future Possibilities in Industries," and Rev. A. G. Walton on "Engineers as Influential Citizens."

GREAT LAKES, HUDSON & ATLANTIC WATERWAYS ASSOCIATION

The first convention of the Great Lakes, Hudson & Atlantic Waterways Association was held at Buffalo on June 29-30. Fullest use of the New York State Barge Canal, as opposed to the St. Lawrence waterway project, was urged at this meeting, which was addressed by Henry Moskowitz, chairman of the new association, P. H. W. Ross, of the National Marine League, Charles L. Cadle, superintendent of the New York State Department of Public Works, Frank M. Williams, and many others.

ENGINEERING OUTINGS

Now, while engineering construction is so slack, and especially while it is hard to promote new enterprises during the vacation time, the members of local organizations of engineers, contractors and officials should improve the opportunity for informal gatherings that will promote friendships, mutual appreciation and open the way for future amenities. Members and guest meeting at headquarters with a few automobiles can spend a few hours on many pleasant social trips and incidentally be welcomed at points of technical interest.

PERSONALS

Maxwell, W. D., has been reappointed engineer of Sac county, Iowa.

Morse, Fred S., has been appointed city engineer of Springfield, Ill.

Leventon, H. L., superintendent of the Placerville-Lake Tahoe unit of the Lincoln highway, has been appointed assistant engineer and assigned to the Sacramento division of the California State Highway Department.

Hengst, N. C., has been appointed engineer of the Barry county, Michigan, road commission.

Torras, R. W., has been appointed to the city planning commission of Atlanta, Ga.

Clark, F. M., is construction engineer for the Maine highway commission.

Chase, Clement E., has been appointed principal assistant engineer of the Delaware River Bridge Joint Commission with headquarters in Philadelphia, Pa.

NEW CIVIL ENGINEERING FIRM

Maj.-Gen. W. M. Black, U. S. A., retired, Charles A. McKenney and John Stewart, formerly president and treasurer of the Cranford Construction Co., Cincinnati, Cleveland and Pittsburgh, announce the formation of the engineering firm of Black, McKenney & Stewart, for consultation, organization, administration, river and harbor, port and terminal, municipal and highway engineering, investigations and surveys, reports and designs. Office at 618 17th street N. W., Washington, D. C.

BOOK REVIEW

COLLECTION AND DISPOSAL OF MUNICIPAL REFUSE

For ten years past there has been in preparation a book on refuse collection and disposal by Rudolph Hering, with whom later Samuel A. Greeley collaborated, and the result has just been published by the McGraw-Hill book company. There can be no question that this is the most complete and authoritative work on this subject which has yet appeared in this country. The high standing of both of the authors is guarantee of the reliability of the information given. Dr. Hering has been prominently identified with refuse disposal since serious attention first began to be paid to it in this country and, in fact, did much to stimulate the discussion and investigation of the subject and development of modern methods.

In the preparation of this book the authors have consulted comparatively all of the literature on the subject published in this country and much of that published in Europe as well; the majority of this being in the form of reports of investigations and of the annual operation of municipal departments. Probably practically all of the data based upon reasonably reliable records or investigations have been studied and many of them have been embodied in the book in the form of tables. In fact, the tables and illustrations occupy about 40 per cent of the 634 pages. The text contains numerous quotations from the more important reports on the subject treated of. There are given a considerable number of cost records, most of them pertaining to the period before the war; however, the date to which the costs refer is given in most cases, which is very essential considering the very great effect of the war upon all cost records.

The seventeen chapters refer to "Refuse Materials," "House Treatment," "Collection," "Supplemental Transportation," "Estimating the Cost of Collection and Transportation," "Outline of Methods of Final Disposal," "Depositing in Water and on Land," "Feeding Garbage to Hogs," "Sorting Rubbish," "Incineration of Refuse," "Reduction of Garbage," "Estimating Costs of Final Disposal," "Stable Refuse," "Street Refuse," "Night Soil and Dead Animals," "Procedure in Small Towns and Villages."

The treatment of the chapters is uniform throughout in that facts and figures are given concerning different cities or as derived from different authorities, including such tables and other data as were available and seemed fairly reliable; and at the end of each chapter is a brief "summary," "conclusion," or "summary and conclusion." These summaries and conclusions occupy less than a page in practically every case. The twelve or fifteen pages which would be occupied by these if combined in one section form an excellent brief resume of the information given in the book, but, of course, in this brief space only the barest outline or general statement of the subject can be made. For instance, under the subject of house treatment the summary and conclusion are as follows:

> The details of the house treatment of refuse discussed in this chapter should serve to show and to emphasize its importance: Specific conclusions pertaining to all conditions cannot be drawn. It is necessary to study this subject carefully, together with a consideration of the organization and routine work of the collection department. The relation of the house treatment of the collection service and final disposal requires more attention in its details than has heretofor been given to it; and, to secure the best treatment, the complete co-operation of the householders and the department is necessary. This can be obtained only by patient, persistent and intelligent inspection, as well as guidance, on the part of the officials of the department.

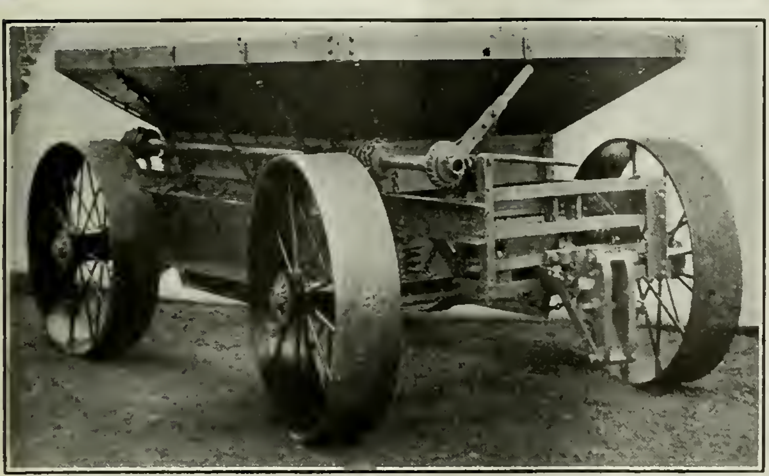
This serves as the summary of a chapter which occupies twenty-three pages.

The longest chapters are those dealing with "Collection," "Incineration of Refuse" and "Reduction of Garbage," these occupying 67, 131 and 56 pages, respectively.

The book is profusely illustrated with photographs of receptacles, wagons, incinerating and reduction plants, garbage dumps and other features connected with the subject which lend themselves to illustration. The price of the book is $7 net.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



REVERSIBLE BOTTOM DUMP TRAILER MODEL MR-3, WEIGHT 4,050 POUNDS

MIAMI TRAILERS

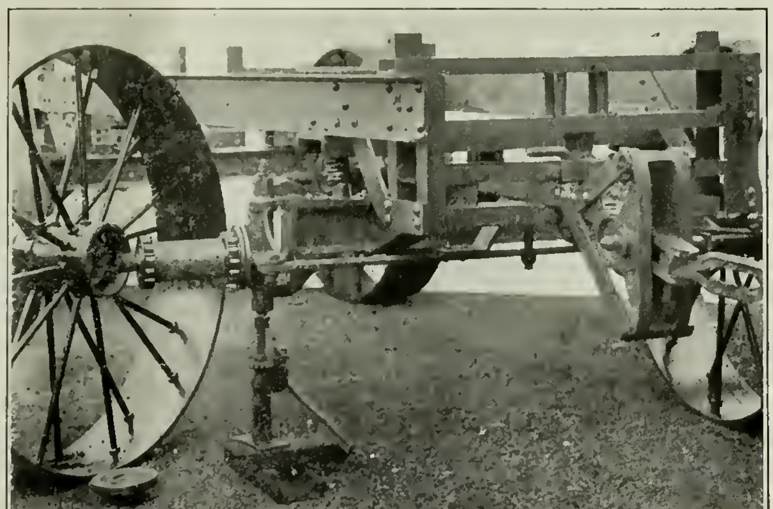
The Miami Trailer Co. is equipped with 8 years of successful manufacturing experience and a large modern factory devoted to the production of trailers of various sizes and patterns for commercial and construction operations. They are built in 14 or more models with capacities of 1,000 to 12,000 pounds. The 4-wheel trailers have draw-bar connections to two points of the front axle, at each end, and the front axle is connected through a reach to five points of the rear axle, relieving the frame and springs of all pull. The steering gear has only two wearing parts, both of them in the fifth wheel where they cannot affect the steering.

The trailer construction on the 3-point suspension system enables either front wheel to drop into a rut without rocking or straining the frame under the load The different models of trailers are equipped with platforms and various styles of bodies. Model No. 126, of 12,000 pounds capacity has a 14-foot coupling pole, artillery wheels, two sets of bolsters, one for the truck and one for the trailer, a heavy cast steel ball hitch, and weighs 4,000 pounds.

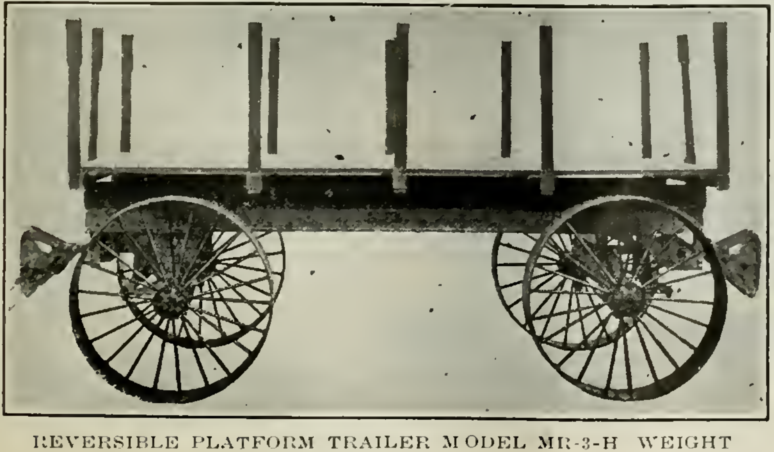
The pipe trailers are built especially to withstand unusually severe strains and rough service, and the parts are oversize, and overstrength with a margin of safety of 100 to 700 per cent at all vital points. The frame construction is designed to form a very strong boxing for the pole and thus eliminates the necessity for balancing the load. The cast steel bolster dogs are built to withstand the great weight of 30 tons and are easily adjustable to any positions on the swinging bolsters to which they are secured by a positive locking device independent of the weight of the load. The Miami hitch is semi-automatic in action, and so flexible that the trailer can be turned through a 45-degree angle without binding. It has a sheering strength at the pin of 60 tons, it contains no small parts and can be quickly connected.

Model No. 123 has artillery type wheels, a 60-inch bolster, tracks 56 inches, and weighs 2,000 pounds crated, while the 126 model has a rated capacity of 6 tons, and weighs 3,200 pounds. Both of them and the intermediate size take loads from 10 to 35 feet long.

The latest additions to the list are two reversible slow-speed trailers of the bottom-dump type with section stake bodies for hauling general freight. The model MR-3 has a wheel base of 7 feet 8 inches, 11 feet 1 inch x 42-inch chassis frame, 10 gauge reinforced steel bottom doors, 5-inch I-beam axles, dust and waterproof hubs, high pressure lubrication, and a capacity of 3 cubic yards water measure or 10,000 pounds, and a weight of 4,000 pounds



DETAILS OF CHASSIS AND AXLE



REVERSIBLE PLATFORM TRAILER MODEL MR-3-H WEIGHT 3,600 POUNDS

GRINNELL SPRINKLERS

The advantages of the new Grinnell sprinkler system for fire protection in low-water-pressure cities, are demonstrated in the Grinnell Bulletin for July, where it is said that in New York, Chicago, Philadelphia and Detroit alone there are many millions of dollars' worth of property that have been denied the benefit of sprinkler protection on account of the low pressure of the city water supply and the cost of introducing auxiliary elevated tank supply.

To solve this difficulty the Grinnell improved booster pump sprinkler system, in which an automatic electric pump is utilized to build up any required pressure and maintain it indefinitely is described. The pumps of the new system are practically the same as those of any single source sprinkler system supplied by city water, except that the whole pump unit is cut into the system between city connection and the main riser, the capacity of the pumps being determined by the size, construction and contents of the building to be protected. The pump takes suction directly from the water main, builds up the pressure into sprinkler system of the required amount and stops working, automatically, resuming operation as soon as built up pressure falls appreciably anywhere in the system.

Where the American District Telegraph Supervisory Service is available every one of the Grinnell improved systems can be periodically operated by means of a special valve and certain supervisory instruments demonstrating the prompt operations and the condition of the apparatus.

STAMP TRUCKMIXER

The Stamp Truckmixer, manufactured by the Truckmixer Co., is a concrete mixer mounted on a truck in place of the truck body. The ordinary batch body with its hoist is replaced with a specially constructed frame which fastens onto the chassis and supports a concrete mixing drum. The power formerly used to operate the hoist is transferred to the drum, making a direct and efficient drive.

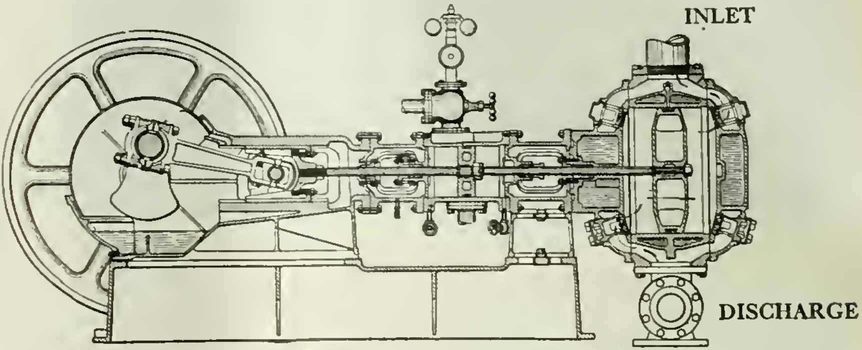
The entire mixer, with its mechanism, has fewer parts than the ordinary dump body and hydraulic hoist. Stone, sand, cement and water are put into the drum direct from bins and the truck is hauled to the site for concreting roadway or other structures. Mixing is preferably done on the final stretch, just before discharging. When it arrives at the place of laying the concrete, the truck is turned around and backed up—the mixed batch is discharged by gravity into a chute which delivers the material to the rear of the truck, and as it moves forward, the chute spreads the concrete so that only a minimum of hand spreading is necessary.

The Truckmixer eliminates the paving mixer, with its crew of wheelers and operators. It takes considerably less time to discharge the mixed concrete than to dump two or three batches into the mixer skip. There is no mixer to limit the output and even if the length of haul is reduced, the trucks can make more trips.

MIXING CONCRETE DURING TRANSPORTATION, USING AUTOMOBILE EXCESS POWER

DRY VACUUM PUMPS

The double cylinder, steam and belt driven WA-61 and WG-61 dry vacuum pumps manufactured by the Sullivan Machinery Co. are built in capacities ranging from 300 to 1,600 cubic feet displacement per minute.



STEAM-DRIVEN VACUUM PUMP, SHOWING VACUUM CYLINDER WITH WHICH SOME SIZES ARE PROVIDED

One of their principal features is the Sullivan improved wafer type valve. It is compact, low in lift, light in weight, indestructable, requires no attention, is noiseless in operation, and functions under exceedingly low pressures.

The pumps are built on the interchangeable part system, and are of the center crank pattern with main bearings, crank shafts and fly wheels at one end and steam and vacuum cylinders at the opposite end. The vacuum cylinder, barrel, and head, are completely surrounded by water jackets. The valves are employed in multiples of relatively small size and the vacuum cylinder is lubricated by a high grade sight feed cylinder lubricator, which will contain enough oil for several days' run. The pumps are either belt driven, steam driven, simple or duplex, and are made in 13 different sizes and patterns, with displacements of 610 to 2,200 cubic feet per minute

HOISTS FOR TUNNEL SHAFTS

The S. Flory Manufacturing Company, Bangor, Pa., supplied five electrically driven shaft hoists for the Shandaken tunnel. These hoists are specially designed for shaft operation and are of the same type as those supplied by the Flory Co. to a number of other contractors on the Catskill Aqueduct work for shafts on tunnel contracts. Two of these hoists have drums 54 inches in diameter and 66 inches long ,while three of them have drums 54 inches in diameter and 48 inches long, the length of the drum being determined by the depth of the shafts. The drums are keyed to the shafts and bolted to the gears. Each drum is equipped with two differential brake bands lined with asbestos blocks so connected that one of the bands has contact in each direction of rotation, both of them handled through one operating lever, which is inserted in a notched quadrant with thumb latch. The hoists with the smaller drums are driven through 112 h. p. motors and those with the larger drums through 150 h. p. motors, the motors being General Electric make, type ITC, reversing and equipped with drum controllers of the semi-magnetic type.

An important feature of the hoist construction is in the design of the drum bearings. The ribs of these bearings are heavily reinforced, and the bearing cap has a slot machined in same over which there is fitted a heavy steel U bolt which passes over the slot and through the body of the bearing housing down into the concrete foundation. The object of this type of construction is to maintain perfect drum shaft alignment, as the principal stress is the tendency to lift the shaft out of its bearing.

Hoists of practically the same design were supplied by the Flory Co. to Mason & Hanger Co. for their contracts on the Moodna tunnel, their New York City pressure tunnel, Pittsburgh Contracting Co. for their New York City pressure tunnel, Oscar Daniels Co. for their Cornwall tunnel and Flynn-O'Rourke Co. for the shafts on the Montague Street East River tunnel.

All of these hoists were operated continuously 24 hours a day and finished their jobs in such good condition that most of them have been sold to coal mining companies throughout the country and are now installed in these mines handling coal.

PUBLIC WORKS.

CITY COUNTY STATE

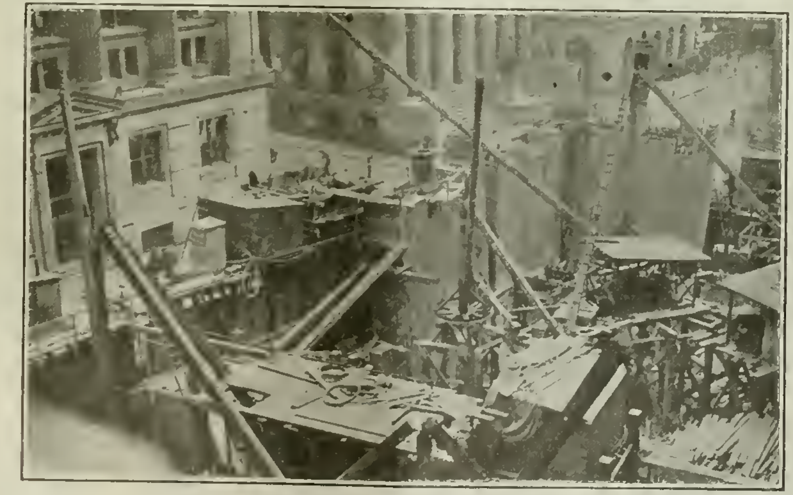
A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 **JULY 30, 1921** **No. 5**

N. Y. Stock Exchange Foundations

Deep general excavation in quicksand and foundations for interior columns of tall steel building extension made inside permanent sectional concrete cofferdam 40 feet high, consisting of wall column piers sunk to bed rock by pneumatic caisson process and temporarily braced with 4 tiers of compound 12 x 12-inch cross lot braces.

The 21story steel frame addition being built to the Stock Exchange, New York, is trapezoidal in plan with fronts of about 141 feet on Wall street, 97 feet on New street, 60 feet on Broad street and 153 feet on the south side, adjacent to the old Stock Exchange building. It has three basements below curb level, the floor of the lowest being 63 feet below the curb. The substructure is built on solid rock at an average depth of about 65 feet below the curb and about 45 feet below ground water level. The soil consisted of about 55 feet of clay, sand and quicksand and 8 to 10 feet of hardpan overlying approximately horizontal sound rock, the surface of which pitched about 5 feet in the length of the building.



WALL CAISSONS CONCRETED AND STRIPPED READY FOR SINKING

CONTINUOUS WATERTIGHT FOUNDATION STRUCTURE

In order to carry the foundations to rock, to exclude water, and to provide the massive retaining walls to resist the unbalanced external pressure of water and quicksand, the concrete piers for the wall columns for three sides of the building were designed to form a continuous watertight structure, 7 feet thick, extending about 40 feet, from a little above ground water line to a little below the original surface of the rock on the three street sides of the lot, and joining the similar construction of the existing building on the fourth side of the lot.

This formed a complete watertight enclosure in which it was easy to excavate down to the surface of the rock in the open and avoid the trouble from quicksand, the danger of undermining the adjacent streets, and the expense of pumping. This has been successfully accomplished by the contractors, the Underpinning and Foundation Co., who built the piers for the foundation columns in pneumatic caissons sunk separately and subsequently connected by massive concrete joints that bonded them together and made a continuous watertight construction.

There are ten rectangular wall caissons 7 feet thick, 40 feet high and from 20 to 29 feet in length, and one special caisson 21 feet long with a width of 11 feet to enable its walls to clear two old cylindrical piers 6 feet in diameter near the center line of the location of this caisson.

CAISSONS AND DERRICKS SERVING THEM

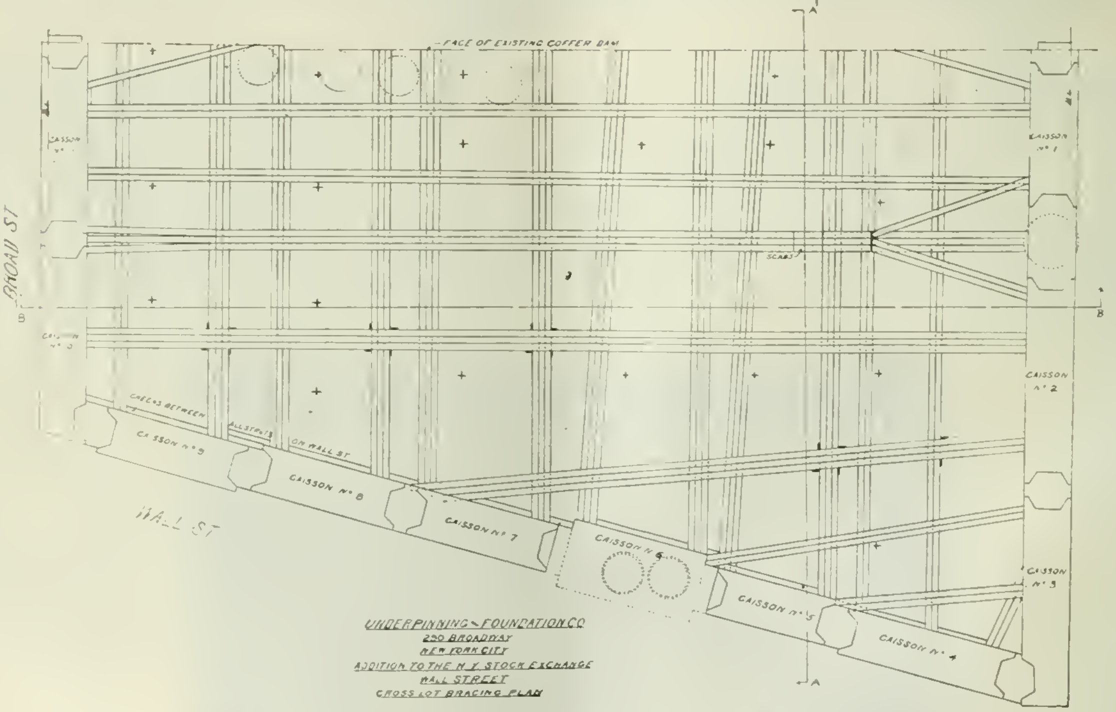
After the building that formerly occupied the site had been removed, four stiff-leg derricks with wooden booms about 60 feet long were installed to command the site and portions of the adjacent street and to handle materials and plant in and out of the lot. Three of the derricks were equipped with Lidgerwood double-drum skeleton steam operated hoisting engines and were provided with Terry & Tench fittings. All of them were installed at approximately street level, three of them being supported on sets of three 20-inch I-beams 40 feet long spanning the corners of the lot and providing for working clearance underneath. The fourth derrick was supported on a falsework tower made with four 15-inch steel pipe piles 40 feet long, driven to hardpan without removing the

The walls of the working chamber, 3 feet 4 inches thick at the top, were offset on the inner faces to a thickness of about 10 inches at the bottom, where they were protected by 8 x 8 x ½-inch steel angles forming the cutting edge. They were reinforced by vertical, horizontal and inclined ¾-inch bars extending above the roof of the working chamber. Each caisson was provided with a central vertical air shaft 3 feet in diameter with two 3-inch low pressure and two 1½-inch high pressure air pipes and two 1½-inch air vent pipes.

The end walls of the caissons were made the same as the side walls, but on their inner faces there was built a trapezoidal core in cross section, that formed, in the concreted pier, a semi-horizontal recess 18 inches wide reaching from the roof of the working chamber to the top of the caisson.

EXCAVATING AND CONCRETING

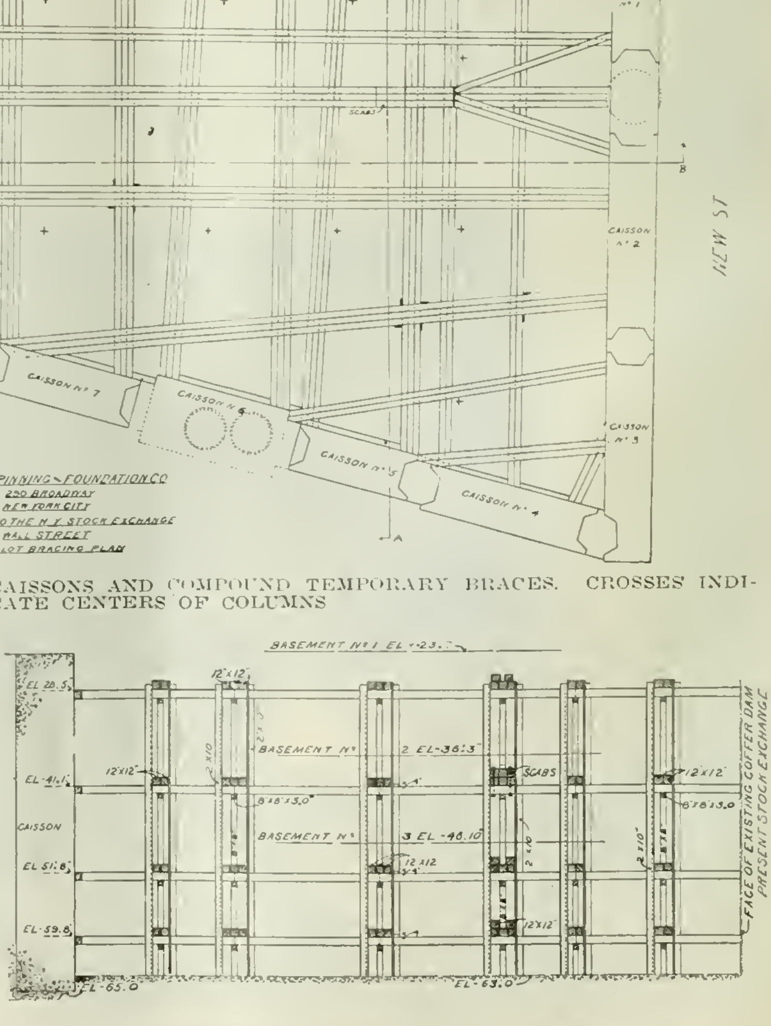
The caissons were well braced and concreted to their full height in three courses, requiring a total amount of about 3,200 cubic yards of concrete, mixed in a 1-yard Ransome machine.



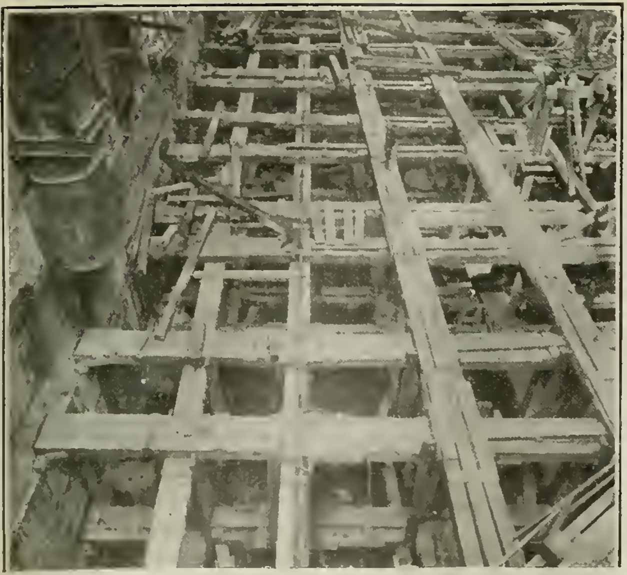
ARRANGEMENT OF WALL COLUMN CAISSONS AND COMPOUND TEMPORARY BRACES. CROSSES INDICATE CENTERS OF COLUMNS

core that entered freely through the open lower end.

The wooden inner forms for the working chambers of the pneumatic caissons were built at the contractor's yards and delivered in halves by motor trucks. They were assembled in position at the bottom of the general excavation, which was carried down below the old cellar floor to a depth of about 20 feet below the curb, approximately to ground water level. The exterior forms of 3-inch vertical planks, spiked to external horizontal transverse screw end ¾-inch tie rods about 2 feet apart in tiers 4 feet apart vertically.



VERTICAL CROSS SECTION AA THROUGH BASEMENT STORIES SHOWING TEMPORARY CAISSON BRACING



COMPLETED EXCAVATION AND BRACING

As there was little room on the lot for carrying on the construction operations and none at all for storage of materials, the work was somewhat hampered by the necessity of delivering aggregate daily from the contractor's yards and from the dealers. The excavated material from the lot was shoveled by hand into buckets hoisted by the derricks and dumped directly into trucks on small working platforms at street level just outside the building line.

During the day the trucks were dumped at the foot of Wall street, less than half a mile away, but at night this dump was not available and the material excavated then had to be hauled several miles to a dump on Long Island. This requirement and the congestion of traffic and crowded streets caused considerable delay and expense.

As it was necessary to avoid any obstructions to either street or sidewalks adjacent to the building, the contractors provided heavy platforms on three sides of the building about 15 feet wide and 12 feet above the curb, which protected the sidewalk and were strong enough to carry a load of 300 pounds per square foot, thus enabling them to be used for storage, for small shops and for offices that commanded the work and caused no obstruction.

CAISSON SINKING

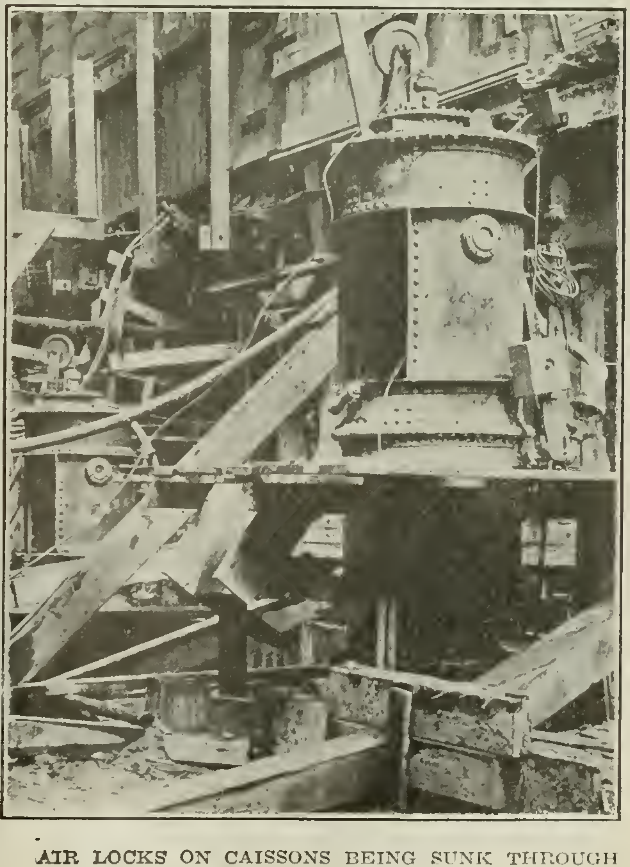
Alternate caissons were sunk in the usual manner by a crew of about 25 sand hogs in each of three 8-hour shifts daily, thus carrying on the work continuously until the caissons were sunk from 3 to 6 inches below the surface of the rock, which was leveled to receive them by drilling and blasting. The caissons were sunk and concreted under a maximum air pressure of about 25 pounds above atmospheric.

The forms for the working chamber of caisson No. 6, 11 feet wide, enclosed and cleared the upper end of the pair of old cylindrical concrete foundation piers that were removed as the caisson was sunk. Eight other similar piers encountered in the lot near the south wall of the building and elsewhere were removed as the open excavation was made around them. These piers, which had been sunk to rock about 20 years ago by John F. O'Rourke with the pneumatic caisson process, were in excellent condition and were still enclosed by the vertical wooden staves attached to inside horizontal angle rings originally placed there for the caisson forms or cofferdams. Holes were drilled through the staves and into the concrete, and the latter was blasted, the staves acting as a sort of protection to prevent the concrete from flying. After the concrete was broken up it and the staves were removed without difficulty.

On the New street side of the lot there existed a similar cylindrical concrete pier, 8 feet in diameter, which was preserved to form a portion of the permanent retaining wall there, as it was fortunately located on the center line of the new caissons that were subsequently bonded to it in the same manner in which they were connected to each other with vertical keys concreted into recesses cut in the surface of the old pier.

BONDING CAISSONS TOGETHER

The caissons were sunk with a clearance of 2 feet between their adjacent ends, and after their sinking had been completed wooden sheet piles were driven on the inner and outer faces of the caissons across the openings between them and the material between them was excavated to a depth of 5 feet and the exterior wooden forms that had been allowed to remain on the ends of the caisson when the side forms were removed before sinking were cut away together with the core boards previously mentioned in the ends of the caissons, leaving the recesses in the ends of the adjacent caissons opening into the space between the caissons.



AIR LOCKS ON CAISSONS BEING SUNK THROUGH QUICKSAND TO BED ROCK

A steel air shaft was set in the center of the space between the caissons and was concreted into a concrete slab filling all the space around it up to the surface of the ground. An air lock was installed on the top of the air shaft, air pressure applied, and the materials between the caissons excavated under pressure, the ends of the caisson forms being removed and the space between the caissons sheeted on each side as the excavation progressed to hardpan, where it terminated and the whole of the shaft thus produced was concreted under air pressure, the concrete extending into the recesses in both caissons and forming a bonded joint between the two.

Where the south ends of caissons No. 1 and No. 11 abut against the wall of the old Stock Exchange building vertical recesses 12 inches deep and 6 feet wide were cut in the face of the old building caisson opposite the end of the new caisson, air locks installed, and the material underneath excavated, and the cuts in the old caissons were extended downward to hardpan and subsequently concreted to form joints there similar to those between the new caissons.

A similar joint was made between the old 8-foot cylindrical pier and the adjacent new caissons Nos. 1 and 2, thus completing the continuity of the watertight construction around all four sides of the lot.

OPEN EXCAVATION OF DRAINED QUICKSAND

After the completion of the wall caisson, the entire area of the lot enclosed between them was excavated down to hardpan without difficulty from water or quicksand. As no water entered through, between, or under the caissons, the small amount contained originally in the soil was easily removed by a 6-inch centrifugal pump with its suction in a sump maintained a few feet below the bottom of the progressive excavation, and thus drying the soil so that it lost its quicksand character and was easily handled by pick and shovel.

TEMPORARY WALL BRACING

As the excavation progressed the exterior pressure on the caissons was resisted by horizontal cross-lot bracing consisting of sets of longitudinal, transverse, and diagonal 12 x 12-inch timbers in four successive tiers supported at intersections on vertical posts, and arranged to clear the steel framework subsequently erected.

The first tier, about 25 feet below the curb, engages the inner faces of the caissons near their upper ends and was put in place as soon as the excavation had been made a few feet below it so as to allow headroom for working clearance under the braces.

After the excavation had been carried about 13 feet farther, a second tier was installed and subsequently the third and the fourth tiers 8 feet and 10 feet lower, respectively, the lower tier being about 6 feet above the cutting edges of the caissons.

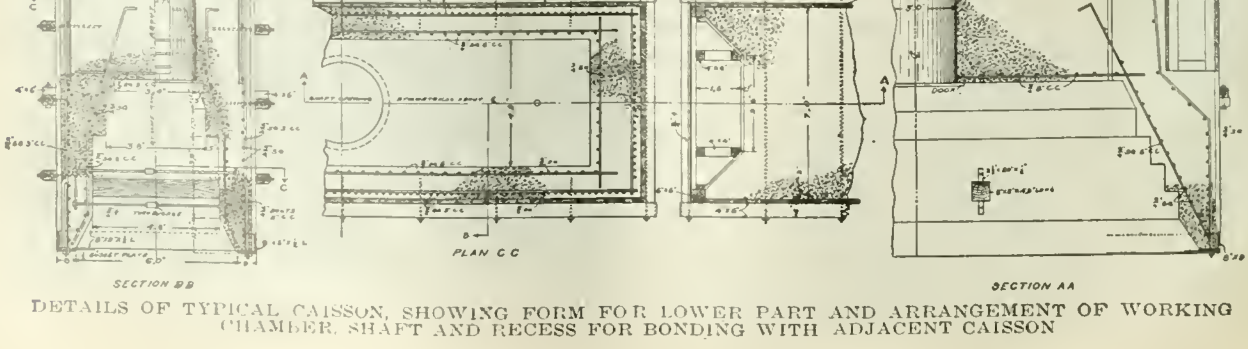
The braces were made in sections of convenient length with staggered butt joints without framing, cutting, or much bolting, and the braces were adjusted by pairs of folding steel wedges 2 inches wide, driven between pairs of steel bearing plates separating the ends of timbers and the faces of the caissons.

It was assumed that the caissons would be subjected to an unbalanced pressure equal to the full theoretical hydrostatic pressure on the exterior face of the caissons, and the timbers were proportioned for a working strain of 5,000 pounds per square inch. They contained in all about 300,000 feet B. M. of timber, which was uninjured and will have a high salvage value after it is removed when the steel framework has been put in place and the lower floors built and brought to bearing against the caissons so as to serve as permanent bracing for them, releasing the timber in the temporary timber construction.

Sidewalk vaults about 12 feet wide will be built above the tops of the caissons, and the earth in the street will be retained there during construction by about 8,000 square feet of 3-inch tongue and groove sheet piles, 25 feet long, driven by a No. 3 McKiernan-Terry steam hammer. The piles will be driven against the existing brick walls, which will then be removed and new permanent walls built in their place. This, however, will not be done until the steel framework for the building has been erected to the second floor above street level so as to afford reaction for bracing the old walls.

The principal mechanical equipment installed on the job by the contractors included Ingersoll-Rand BCR jackhammer drills, and Denver Rock Drill Company's Waugh hammer drills, 6 Matson air locks, about 250 tons of 2-ton cast iron ballast blocks for sinking the caissons and the usual equipment of miscellaneous plant and small tools.

The work has been executed by Marc Eidlitz



DETAILS OF TYPICAL CAISSON, SHOWING FORM FOR LOWER PART AND ARRANGEMENT OF WORKING CHAMBER, SHAFT AND RECESS FOR BONDING WITH ADJACENT CAISSON

& Son, Inc., general contractors, with a maximum force of 75 to 100 men under the direction of W. P. McKibben, general superintendent, and S. G. Brett and H. Williams, engineers. Trowbridge & Livingston are the architects of the building and Daniel P. Moran is consulting engineer.

San Francisco Bay Bridge

The agitation for a bridge across San Francisco bay has finally reached the definite point of a preliminary report by two engineers of national reputation, John V. Davies and Ralph Modjeski. These engineers were employed by a bridge committee appointed by San Francisco, Alameda and San Mateo counties and others, to report upon the feasibility and best general plan of connecting San Francisco with the cities across the bay by tunnel or bridge for carrying both railway and the vehicular traffic.

After a preliminary investigation of several days, these engineers recommended a combination structure consisting of about 3,500 feet of subaqueous tunnel crossing the channel and rising by a long incline to a bridge about 12,000 feet long over shallow water, which bridge is succeeded by 3,000 feet of pile trestle and this in turn by about 12,000 feet of fill.

The engineers call attention to the fact that this project, if carried out, will be a unique structure. The entire crossing might possibly be made in tunnel but it is extremely questionable whether it would be practicable to ventilate a tunnel the length of this, through which automobiles will be passing and contributing gasoline fumes. A preliminary estimate of cost is given as $40,000,000, which is believed to be ample to cover preliminary surveys, engineering, construction, interest on money during the construction period and all other items. The engineers suggest that charges be made of 5 cents per passenger and 75 cents per vehicle, which, with tolls from railroad, freight, electric ducts, etc., should bring in over $1,500,000 the first year, increasing to $3,630,000 the fifth year and continuing to increase thereafter. Their estimate would indicate that the interest charges on the utility would not be earned until the fourth year of operation, but thereafter the returns should be fairly satisfactory and initial deficits made good. This calculation is made with the assumption that the project will be constructed as a private enterprise, but the engineers are of the opinion that it should without question be ultimately acquired, owned and controlled as a municipal one.

The Waste of Water in Detroit*

Result of a study of consumption, including Pitometer survey and meterage record of a city that is 98 per cent metered, extending over several years. Domestic, commercial, and municipal consumption by day and night.

For a number of years the water department of Detroit has been making a special study of the matter of water waste. At first this was confined largely to house to house inspection, but beginning with 1914 metering was extended to include practically all consumers. In May, 1919, when nearly 100 per cent of the services had been metered and the consumption was still found to be high, the Pitometer Company was employed to conduct a water waste survey of the distribution system of the city. This survey is still being continued, five of the seven sections into which the city is divided having been completely surveyed by May of this year, and about 50 per cent of the sixth section.

There are several reasons why information concerning consumption and waste of water in Detroit should be of unusual interest. The system was installed nearly 100 years ago and pipes laid eighty years ago are still in service; 98 per cent of all active service connections are now metered; the system is a direct-pressure one and hourly records of consumption are therefore available; it is the largest city in the United States that has nearly all of its connections metered; and the entire supply used for domestic purposes is obtained from the public system, the water available from wells being negligible.

The distribution system contains 1,480 miles of cast iron pipe from 4 to 48 inches diameter and 3 miles of 48-inch steel pipe.

A reservoir was used until 1887, when it was discontinued and since then the system has been operated as a direct-pressure one. Since 1913 all water pumped has been metered at the pumping station; in calculations made before 1913 allowance was made for pump slip.

In 1882 the per capita consumption was given as 120 gallons a day and as 209 gallons in 1887. By 1891 this had fallen to about 150 gallons. The marked decrease from the high consumption rate in 1887 was due to at least three causes—the use of meters (although the number set was small), careful inspection of premises, and the elimination of waste at the pumps. In explanation of the last it may be said that the pumps were two of 24,000,000 gallons capacity each and that during a considerable part of the time the capacity of the pumps when working at minimum speed was greater than that needed to supply the city, and large quantities of water were allowed to flow back into the suction well. The introduction of by-passes permitted the capacity of the pumps to be changed at will to 12,000,000 gallons per day.

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*Abstract of a paper before the American Water Works Association by George H. Fenkell, General Manager of Water Department.†

WASTE SURVEY

Much of the information was obtained from the Pitometer survey. The total number of service leaks found by this survey in 80 per cent of the area of the city surveyed up to May 1, 1920, was 447, wasting approximately 10,000 gallons per day for each service; 116 were found to be wasting about 23,300 gallons each.

The survey had located, uncovered and stopped leaks in mains amounting to 2,533,000 gallons per day. Altogether the survey had stopped underground leaks from all causes amounting to about 7,000,000 gallons a day. About one-half of all the mains in the city and 80 per cent of the population are included in the area surveyed and it seems probable, therefore, that when the survey has been completed 10,000,000 gallons of underground leaks per day will have been stopped.

The purpose of the survey was not only to locate and stop underground leaks in mains and services, but also to check up all industrial consumers and discover unauthorized use of unmetered water. It included a field test of all meters larger than three inches in diameter. Each of the seven sections of the city was divided into as many districts for individual study as was made convenient by the location and size of the larger mains of the distribution system; 120 districts have been measured to date and permanent gaging points established in each district for the future control of waste. The total minimum night rate in the districts measured amounts to 86 gallons per capita per day.

In spite of the fact that 98 per cent of the services were metered, in many instances the rates of flow were so high as to indicate heavy leakage and yet no leaks of mains or services were found to exist. Here house to house inspections were made and these high rates were found to be caused by leaking plumbing fixtures.

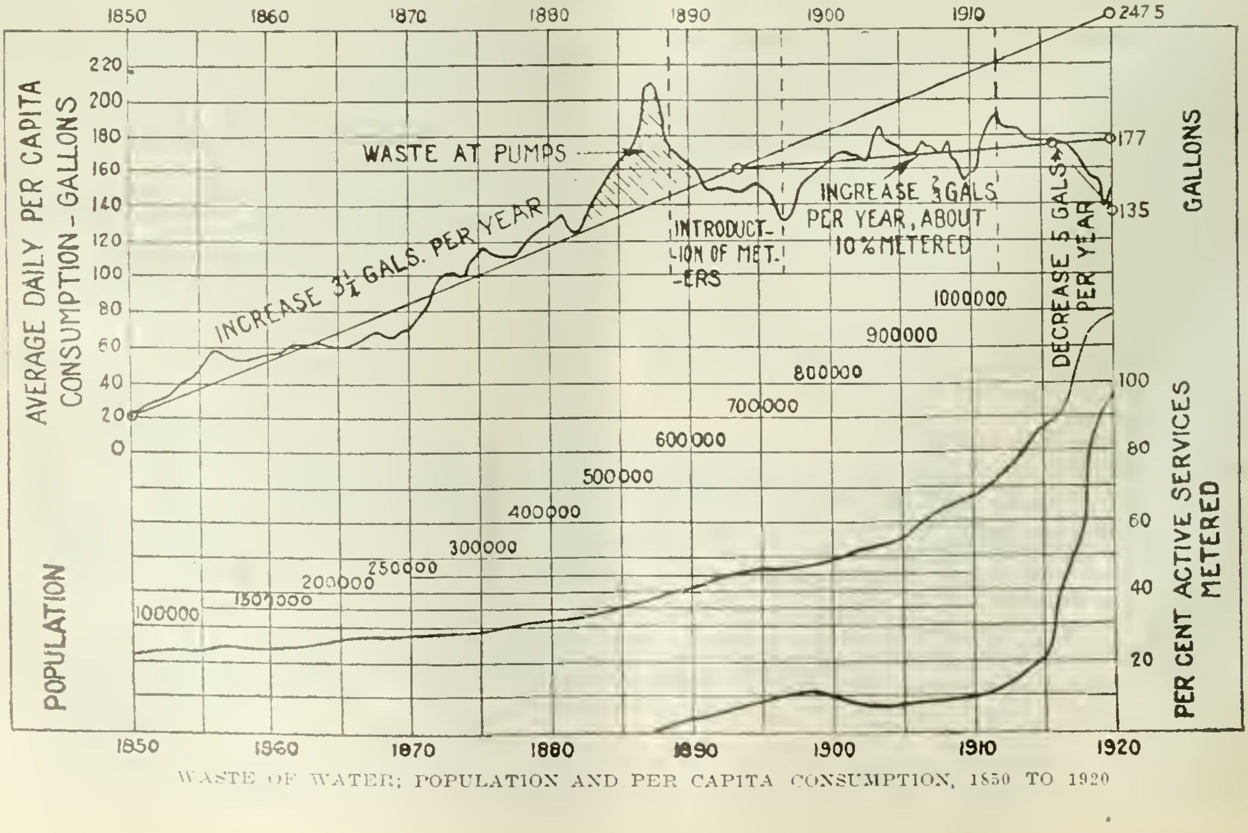
Meters larger than three inches to the number of 356 have been tested and in many cases under-registration has been found and repaired. So far no unauthorized use of water has been discovered, which may be accounted for in part by the metering of many fire lines and the careful inspection of the remaining fire lines.

The survey revealed four broken mains leaking 562,000 gallons a day, twelve joint leaks of 861,000 gallons per day, three open blow-offs flowing 800,000 gallons, two blown plugs 190,000 gallons, three valves with bad stuffing-box leaks 85,000 gallons, and two defective fire hydrants leaking 35,000 gallons: a total of 2,533,000 gallons per day. Leaks were found in 116 service pipes caused by broken pipes, abandoned services and blown corporation cocks, the total leakage from which was 2,704,000 gallons per day. This gives a total leakage of 6,892,000 gallons.

ANALYSIS OF CONSUMPTION

A large part of Mr. Fenkell's paper is devoted to figures and calculations based upon meter measurements, pump records and other data and assumptions. In using meter records an allowance of 5 per cent was made for under-registration of meters.

The number of metered domestic accounts was arrived at by subtracting from the accounts where meters were 1½ inches or smaller the number of commercial accounts as determined by careful examination of the city directory. The amount furnished 2,985 domestic flat-rate accounts is estimated by allowing 1,000 gallons for every five cents of flat-rate revenue.



WASTE OF WATER; POPULATION AND PER CAPITA CONSUMPTION, 1850 TO 1920

It was estimated that the total amount of water furnished for municipal purposes was 17.44 gallons per capita per day, or 13 per cent of the total quantity of water consumed within the city limits. This includes 0.39 gallons furnished free to charitable institutions and 0.95 at one-half rate to other charitable institutions. Flooding trenches is charged with 7 cubic feet per lineal foot for 200 miles of trench. The estimates for paving, sprinkling and flushing streets, and for flushing sewers are based on data furnished by the department of public works. Other public consumption is that in the 42 engine houses, 15 ladder houses, 11 police buildings, 5 parks, libraries, public schools, etc. The Pitometer Company found the average daily consumption of unmetered park fountains to be 45,000 gallons. The continuous flow sanitary drinking fountains were estimated to use 1,100 gallons per day each. Eight skating ponds were estimated to use 80,000 cubic feet a season each. A careful estimate gave 30,644,000 gallons of water as the amount used in extinguishing fires. From these and various measurements and assumptions the table of consumption given herewith was prepared. It is known that considerable amounts are used that are not included in the table, such as for extinguishing fires in coal piles, street sprinkling wagons in the business district and street sprinkling of car tracks by the street railway.

The Consumption of Water in Detroit

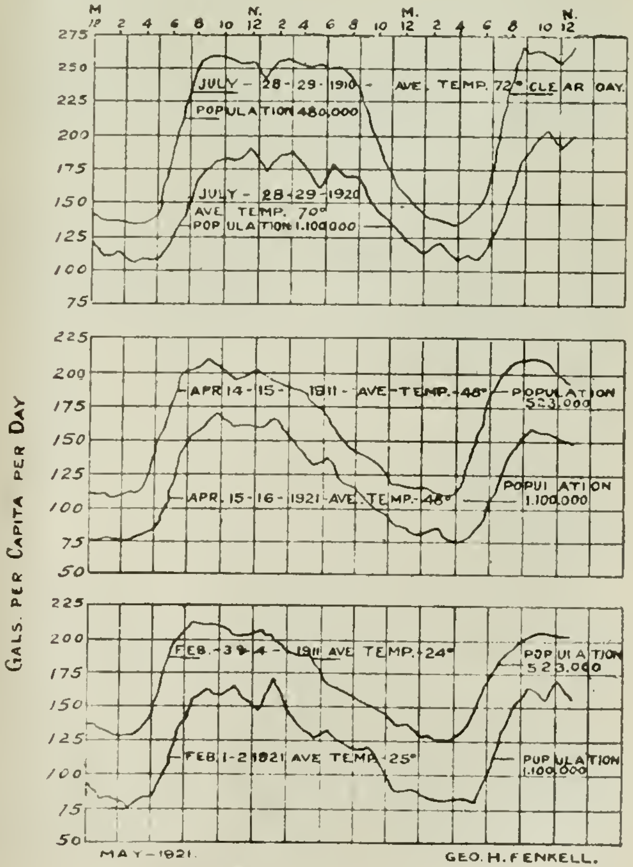
		Gallons Per Capita Per Day	
DOMESTIC			
131,692	Metered accounts	46.48	
2,985	Flat-rate accounts	4.23	
	Service connection leaks	5.45	
		——	56.16
COMMERCIAL			
1,219	Industrial plants and railroads	42.77	
7,416	Accounts—stores, etc.	6.42	
	Building construction	0.21	
		——	49.40
VILLAGES AND OUTSIDE TERRITORY			
25	Accounts—villages	9.62	
14	Accounts—factories	3.53	
		——	13.15
MUNICIPAL			
	Flooding trenches	0.16	
	Paving	0.27	
	Sprinkling and flushing streets	0.53	
	Flushing sewers	0.02	
42	Engine houses	0.05	
15	Ladder houses	0.03	
11	Police buildings	0.11	
38	Parks and boulevards	7.23	
12	Park fountains	0.56	
300	Drinking fountains	2.87	
8	Skating ponds	0.01	
14	Public libraries	0.01	
161	Public schools	3.01	
75	Private schools	0.55	
35	Public buildings	0.67	
62	Charitable institutions		
	32 Free	0.39	
	30 Half rate	0.95	
	Fires	0.12	
		——	17.44
WATER WORKS			
	Leaks in mains	3.26	
	Flushing mains	0.72	
		——	3.98
			140.14
	Unaccounted for		4.36
	Average per capita consumption per day determined by Venturi meter measurement July 1, 1920, to April 30, 1921		144.50

Estimate of the Daily Per Capita Consumption of Water Used at Night Rate for Public Purposes

MUNICIPAL

	Gallons Per Day Per Capita	Gallons Per Day Per Capita at Night Rate
Flooding trenches	0.16	0.00
Paving	0.27	0.00
Sprinkling and flushing streets	0.53	0.53
Flushing sewers	0.02	0.00
Engine houses	0.05	0.025
Ladder houses	0.03	0.015
Police buildings	0.11	0.11
Parks and boulevards	7.22	4.00
Park fountains	0.56	0.56
Drinking fountains	2.87	2.87
Public libraries	0.01	0.00
Public schools	3.01	1.00
Private schools	0.54	0.18
Public buildings	0.67	0.50
Charitable institutions	1.33	1.00
Fires	0.12	0.12
Skating ponds	0.01	0.01
	——	——
	17.41	10.92

In only 50 cases was water found running to prevent freezing. This survey, however, was continued throughout the year and covered only part of the city, because of which and of the mildness of the winter it was thought the amount ordinarily wasted to prevent freezing would considerably exceed this. The average waste from one tap to prevent freezing is 2,000 gallons a day. With one tap in one hundred allowed to flow for three months, the average daily waste for the year would be 0.75 gallons per capita, and this is the amount estimated.



HOURLY CONSUMPTION OF WATER IN DETROIT AND SUBURBS—ENTIRE SYSTEM

The summer of 1920 was cool and comparatively little water was used for sprinkling, and the survey, therefore, gave little information on this point. If it is assumed that two-thirds of the services are used for sprinkling one-half hour every second day during a period of three months, the yearly consumption will be 1.8 gallons per capita.

From night measurements made of several residence streets and averages prepared it was estimated that the leakage through defective plumbing fixtures could be taken at 22 gallons per capita. Combining these several figures for night flow Mr. Fenkell obtains the following as the total night consumption accounted for.

Night Consumption Accounted For

	Gallons Per Capita
Manufacturing night consumption, metered, covering district including 80 per cent of the population.....	19.82
Underground leakage, measured, covering same district	8.91
Underground leakage, not measured, 650 miles of mains at 3,000 gallons per mile	2.44
Public night use, estimated	10.92
Night domestic use, estimated	22.00
Total consumption accounted for	64.09

The minimum night rate actually furnished 80 per cent of the districts surveyed was 86.42 gallons, and the difference between this and the 64.09 gallons gives 22.33 gallons as the leakage per day through defective plumbing fixtures.

From an examination of the records of the waste water survey, 4,336 leaking fixtures were located and the waste from 90 per cent of these was measured and that from the balance estimated. The waste averaged 977 gallons per leaky fixture. Assuming that this was 10 per cent below the actual leakage, this gives 23.64 gallons per capita which checks quite closely with the 22.33 gallons calculated as above.

It was known that considerable water is wasted through carelessness but there is no way of determining the amount. It was assumed, however, that each of the connections was allowed to waste for five minutes a day at the daily rate of 3,000 gallons, and this gave an average of 1.5 gallons per capita per day.

Combining these, we have as the estimated daily consumption:

	Gallons Per Capita
To prevent freezing	0.75
Lawn sprinkling	0.90
Leaks in service connections	5.45
Leaks in fixtures	22.33
Carelessness	1.50
Total	30.93

This quantity subtracted from the total domestic consumption leaves 25.23 gallons for domestic use.

In a direct-pressure system, where the plant must be capable of supplying water at the maximum hourly rate, the effect of metering on such maximum hourly rate is of great importance. As shown by the following table, the ratio of maximum hourly rate to average hourly pumpage for each of the last ten years has diminished from 1.73 to 1.55.

1910............	1.73	1915............	1.52
1911............	1.75	1916............	1.51
1912............	1.59	1917............	1.55
1913............	1.75	1918............	1.50
1914............	1.64	1919............	1.68
		1920............	1.55

One rather unusual statement made by Mr. Fenkell is that "consumers have looked on metering with favor and there has been no opposition to the movement from any class." The rule in Detroit has been for domestic consumers to prepare their plumbing for the meter and for the board to set and maintain the meters without charge or rental.

Cement Production in 1921

From information obtained by the United States Geological Survey covering the first six months of 1921, it appears that the amount produced was about 94 per cent as great as in the corresponding period of 1920, and that the production and shipments have both increased considerably since the first of the year. In January, the production was a little over 4,000,000 barrels, and the shipments a little over 2,500,000. Both production and shipments have increased steadily until in June the production was 9,296,000 barrels, while the shipments totaled 10,577,000. This production was slightly greater than that of June, 1920, and the shipments for June were greater than those for any preceding June.

"These figures indicate that the cement industry has enjoyed relatively greater activity than many of the other large mineral industries during the first half of 1921, and that stocks of finished cement and clinker, while not excessive, are ample to supply any reasonable demand."

Winter Bridge Erection in Alaska

The 504-foot channel span of the United States Government Railway bridge across the Susitna river of Alaska has two pin-connected steel trusses, the erection of which on trestle falsework was completed in midwinter when the temperature was at times as low as 42 degrees below zero.

The members were assembled by a 100-ton locomotive crane with a 50-foot boom in the yard. There were required in the 1,800 tons of steel about 42,000 rivets, some of which were driven on days when the temperature from — 12 to — 42 degrees and were afterwards several times tested and demonstrated to be first class. The span was swung and put into service early in February, 1921. The work was under the general supervision of Col. F. Mears, chairman and chief engineer of the Alaskan Engineering Comission. The steel work was fabricated and erected by the American Bridge Company. The designs and details were checked and approved by Modjeski & Angier, consulting engineers.

Trackless Trolley for Akron

Akron, Ohio, is to have a trackless trolley car operated by the local traction company as an experiment. The city may finance trackless trolley car extensions by loaning money to the traction company should the trial car prove a success.

PUBLIC WORKS
Published Weekly
by
Public Works Journal Corporation
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba.$3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
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Commendable Attention to Legislation

A serious and almost universal fault, and one that carries its own penalties, is the unfortunate tendency of individual engineers, contractors, officials and their organizations and societies to content themselves with purely technical activities and neglect the attention they should bestow on commercial, financial and public matters and especially on political activity that may prove a serious menace or that die from lack of proper encouragement when they might be made effective for great public good.

The advantage of a systematized recognition of the importance of attention to legislation that is proposed or in progress, is shown by the record described in this issue of good results promoted by the timely and influential action of the Committee on Law and Legislation appointed by the New York General Contractors' Association, a small but powerful organization, affiliated with the Associated General Contractors of America. This association has long taken an active and intelligent part in the New York legislation affecting construction matters and during the term of the legislature which adjourned on April 16 had under consideration 46 of the total number of 3,960 bills, about 900 of which were passed.

The committee took action on 27 of the 46 bills selected, and of these the final legislation on 25 was satisfactory. This shows very efficient results for 2 per cent of the entire legislation, and a very high degree of efficiency for the work undertaken. The legislation secured improvements in the requirements for retained percentages, in the restriction on water works labor, and in contract payments. The important bills defeated included those having to do with civil engineers' licenses, with transportation costs, paving rates, the employment of double labor on pneumatic hammers, strikes, indemnity and compensation features that might occasion serious damage and inconvenience to construction interests.

It is always difficult and generally impossible for an individual, no matter how well qualified, or even how much leisure and abundant facts may be at his disposal, to successfully promote or combat legislation, but it is entirely within the ability and certainly within the province of organizations for legitimate professional or business interests to give authoritative assistance to their qualified expert representatives. This is one of the aims of the Associated General Contractors of America and should be appreciated and emulated by its affiliated societies and by the other societies and individuals throughout the country who will always find their efforts welcomed by the larger society.

Pneumatic Caisson Foundation in New York

Pneumatic caissons, which have long been used for difficult foundations for bridge piers, abutments, lighthouses, retaining walls, tunnels, shafts, etc., have generally been used only for one kind or another of public work, except in New York City, where for the last 25 years they have frequently been used to carry the heavy column loads of tall office buildings below ground water level to hard stratum.

Their design and method of construction has been highly specialized and perfected. They have proved very efficient and satisfactory under the unusually difficult conditions in New York City, where deep cellar excavations have to be made and foundations sunk through 50 or 100 feet of quicksand to rock bearing.

One of the features of this class of work is the facility with which the foundations for the wall columns have been adapted to form watertight, subterranean enclosures reaching to rock and protecting the entire interior space from quicksand, water and pressure, so that the excavation may be made and foundations built there in great safety and economy. Such work is, of course, adaptable to many other kinds of construction and its advanced practice is exemplified by the job described on page 83, which was executed by contractors with a long record of work executed with uniform success, often under great difficulties for various types of important construction in and around New York City.

The outstanding features of this work are the construction of the monolithic caissons, except for concreting the working chamber and shaft, before sinking was commenced; bonding adjacent caissons together with massive waterproof concrete joints that close the clearances between units and convert them into a continuous retaining wall or cofferdam; the application of similar joints to the connections between the new foundations and those of portions of the old building: the falsework supports for derricks enabling them to be operated without obstructing the very congested area of the lot; the very massive and thorough system of temporary cross lot bracing, designed to give ample protection against any possible hydrostatic pressure on the exteriors of the caissons; and the very excellent condition in which were found a number of concrete piers sunk on the site of the new building by the pneumatic caisson process about 20 years ago and still in perfectly satisfactory and reliable condition.

It is also of interest to note that this work was under construction in a more or less critical stage well within the radius of the frightful Wall street explosion last year and did not suffer any material damage therefrom. The safe and satisfactory execution of this difficult work in treacherous soil adjacent to some of the most thronged thoroughfares in the world, in the heart of the New York financial district, without accident or inconvenience to citizens, obstruction to business, or injury to the costly buildings and treasure houses surrounding it, reflects credit on and inspires confidence in the engineers and contractors who accomplished it as a part of their every-day work.

Free Highway Construction from Politics

Promote in the minds of the American people the idea that they must divorce this one thing from politics, religion and favor. Make them understand, if you can, that while America is rich, rich beyond the dreams of avarice, it is not rich enough—now that hundreds of millions of dollars are to be spent in highways—it is not rich enough to play the highway game as it has played it the last ten years. America must wake up, turn over and start again with the one idea that this is the greatest business enterprise that the American people have ever undertaken and that it must be made a clean-cut and efficient operation.

The fact must be pressed in upon the American people that if they are going to get anywhere near the shadow of a dollar for every dollar they are so willing to spend in highway work, they must divorce that work from the average run of state and county business and put it on an absolutely sane and efficient basis. The men who work in the state highway departments are neither politicians nor grafters. Nine out of ten of them are graduates of high-class colleges and universities—most of them civil engineers. A right highway department, be it state or county, has a personnel of clean-cut, well-educated Americans who are neither crooked nor inefficient and who do not intend to become so; and if you are going to get and retain that kind of men in highway work, you must establish conditions in the business that are just as clean-cut and just as attractive as they are in any other kind of business. Those conditions are almost nowhere prevalent in the American states. You insist in all your promotion work upon efficiency in highway construction. Did you ever think that in the executive offices of the average American state there was no salary ever heard of above $5,000 a year? Most of the governors of the states get that or less. Three out of four of the executive officials of the state highway departments of America get $5,000 or less per year. Is it any wonder that they are not world beaters or record breakers? It is not. The only wonder would be that so many good men are still in the business.—From an address before the Portland Cement Association by A. R. Hirst, state highway engineer of Wisconsin.

Research Studies on Paving Brick

In various branches of engineering work there has become increasingly apparent during the past few years a desire for research into various technical matters by governmental agents, engineering schools of high standing, national societies or other bodies which can secure necessary funds and whose conclusions will be received with confidence in their reliability. Undoubtedly this desire has been increased by certain of our experiences during the war.

Among the researches that have already begun to take form is one which is now under way in connection with burned clay products. This investigation is being made through the co-operation of the federal government, including the Bureau of Standards and the Bureau of Mines, the University of Illinois and others, the American Ceramic Society and the four national associations of brick manufacturers. Representatives of these various bureaus and organizations organized on June 16 a Joint Research Committee. The various associations have agreed to appropriate a considerable sum for the purpose of this research and the Bureau of Mines and Bureau of Standards will contribute two or three times as much.

The work of the research committee will be divided into two parts, the first dealing with the study and investigation of commercial kilns, and the second with the study of the water smoking and dehydration process by the Bureau of Standards, a study of heat absorption through all the burning stages by the University of Illinois, a study of oxidation and vitrification by the Bureau of Mines, and experiments in the study of combustion and the transmission of heat in a semi-commercial kiln by the Bureau of Mines at Columbia. The Bureau of Mines will make field studies of brick burning at various plants, many of the brick companies having offered the use of their plants for this purpose.

The chairman of the committee is F. W. Butterworth, of the Western Brick Company, and the secretary-treasurer is M. B. Greenough, of the National Paving Brick Manufacturers' Association. The technical committee consists of A. V. Bleininger, chairman, of the Homer Laughlin Pottery Company; P. H. Bates, of the United States Bureau of Standards; R. C. Purdy, of the American Ceramic Society; R. T. Stull, of the United States Bureau of Mines and E. W. Washburn, of the Ceramic School of the University of Illinois.

It is encouraging to other industries and to engineers to note the active interest being taken in such practical research work by federal bureaus, bringing to the work federal funds (although these are limited in amount); and it is to be hoped that other research work along engineering and technical lines will be conducted with or without the material aid of the various bureaus of the federal government.

Construction Legislation in New York

Bills affecting contracts, labor, transportation, compensation, accidents and insurance, that were passed or defeated in 1921 and were respectively supported or opposed by the New York General Contractors' Association.

In the June bulletin of the Associated General Contractors of America there was published a review by C. A. Crane of 24 important bills out of 46 before the New York State Legislature that had been under consideration by the association's Committee on Law and Legislation, and pointed out that of these five bills approved by the association were passed and became laws, while 18 that were opposed by the association all failed to pass. Two more bills, favored by the association, were passed and signed by the governor and 19 bills examined by the association received no action from it.

BILLS FAVORED

The laws enacted that met the approval of the association were an amendment providing that retained percentages of contracts heretofore made might be withdrawn by substituting corporate stock or securities of a market value equal to the sum withdrawn; an amendment to the labor law, exempting construction on or for water works outside the limits of cities and villages from the provisions of the 8-hour law; an amendment to the rapid transit act relative to the manner to which action for the recovery of money on subway contracts shall be brought; an amendment to the Walter law of 1918, which was the state-wide relief law for contractors who in May, 1918, held uncompleted contracts which had been taken prior to April, 1917, when the United States entered the war.

Other bills approved by the association included the recodification of the labor law; an amendment to the workmen's compensation law providing that workmen's compensation shall be paid periodically in the place of wages as it accrues; and an amendment to the greater New York charter provided that the award of a contract may be made in cases where the low bid exceeds the appropriation, if an additional appropriation is secured before an award is made.

BILLS OPPOSED

The bills opposed and not passed were an amendment to the civil engineers' license law, which would have prohibited engineering or construction corporations from designing or supervising construction work as corporations; an amendment to the New York charter increasing wharfage and dock rates on lighters and North River barges carrying building materials; an amendment to the greater New York charter providing for the registration of architects, builders and others supervising building construction; an amendment to the greater New York charter permitting Borough Presidents to establish rates per square yard for street restoration; an amendment to the labor law prohibiting wives and children of employees on lighters to live thereon; an amendment to the labor law forbidding the use of any automatic hammers whose piston stroke exceeds 3 inches in length, and 1 1/16 inches in diameter, in the operation of which it is necessary to resist the recoil and vibration of the stroke by the pressure of the hands, arms or body and unless there is another competent man to assist in operation of said hammer; an amendment to the penal law prohibiting advertisements for employees during strikes or lockouts unless it is plainly stated in the advertisement that such a strike or lockout exists; an amendment to the penal law prohibiting all policemen, officers or guards taking part in strikes or other industrial disputes; an amendment to the penal law prohibiting the employment of persons to take the place of striking employees when such persons have not been bonafide residents of the place in which the business of the employer is located for 30 days prior to such employment; an amendment to the insurance law requiring every owner of a motor vehicle to file with the Secretary of State indemnity bonds for not less than $10,000, said bonds to be given for the protection of property or persons injured by the owner of the vehicle; an amendment to the workmen's compensation law permitting injured employees to select their own doctor at the expense of the employer; an amendment to the workmen's compensation law providing that compensation should begin on the day of the injury instead of two weeks after; an amendment to the workmen's compensation law, extending the benefits of the law to employments in which two or more persons are employed instead of four or more as at present; an amendment to the workmen's compensation law increasing the period during which the compensation shall be paid for permanent partial disability; an amendment to the workmen's compensation law compelling the employers to insure exclusively in the state insurance funds; an amendment to the workmen's compensation law providing for the insurance of the employees of a sub-contractor and making either the owner or principal contractor responsible for such insurance; an amendment to the workmen's compensation law including in the definition of the word "employee" a person who during the hours of his employment is engaged in traveling to or from the place of employment; an amendment to the highway law increasing the license fees for motor vehicles and automobile trucks and practically doubling truck licenses; a bill providing for a bond on public work contracts in addition to the bonds given for the faithful performance, such additional bonds being required for the payment of all labor and material furnished on the contract.

Stream Pollution by Industrial Wastes

Advancement in practice of treating wastes and recovering valuable materials therefrom. Ideas of health boards more rational.

At a recent meeting of the mechanical and engineering section of the Franklin Institute a paper was read by C. A. Emerson, Jr., chief engineer of the Pennsylvania Department of Health, in which he reviewed present conditions as to the pollution of streams by industrial wastes and the possibility of preventing such pollution, with special reference to Pennsylvania conditions.

He believed that "the cost of treatment of industrial wastes to prevent stream pollution should undoubtedly be borne by the industries responsible for the discharge. The enactment of rigid control legislation is only a portion of the remedy and might easily place such a burden upon the industries as to seriously disturb the prosperity of the state. Economical and effective methods of treatment must be developed and proven by actual plant operation before we are ready for stringent legislation."

The ideas of health boards are to-day more rational than they were a few years ago, when practically complete purification of trade waste was demanded, and they now "take into consideration the great variation in the physical and chemical composition of the different wastes requiring special treatment processes; the relative values of the industries to the state; the present uses and probable future development of the water course, and the ability of the stream to absorb and purify the waste by natural agencies."

Another forward step has been the realization that many industrial wastes contain matters of value which can be utilized and that many of the objectionable characteristics of wastes can be eliminated by improved methods of manufacturing.

The writer then described at some length the characteristics of wastes from tanneries, wool scouring plants, coke ovens, oil refineries, etc. In the case of tannery wastes the spent liquors can be concentrated by evaporation and used again, hair can be recovered, waste from the lime vats is removed by sedimentation, scrapings from the hides are sold to glue manufacturers, etc. Grease is recovered from the liquid wastes from wool scouring plants by centrifugal separators, one Philadelphia establishment recovering from 180 to 200 pounds of grease per day, which is sold to the refiners at a considerable profit over the cost of operating the separators.

Wastes from tar separators, by-product coke ovens, gas works and similar establishments are of particular importance because of the disagreeable tastes which their wastes impart to water, especially when it is chlorinated. In such cases the waste is excluded entirely from streams used as sources of public water supplies. At coke ovens all objectionable liquid wastes are used for quenching or cooling the glowing coke drawn from the ovens and passes into the air as steam. Water which is not evaporated is re-collected and used again. One coke oven installation in Pennsylvania thus turns into steam more than one million gallons of contaminated water daily.

Salt water from oil wells which in the past has polluted so many Pennsylvania streams is now discharged back into the well outside the pump casing instead of into the streams and serves as a medium for bringing more oil to the surface.

The most serious stream pollution in Pennsylvania is that by the discharge of coal mine drainage, which carries enormous quantities of acids and powdered coal into the streams. It is estimated that over 850,000,000 gallons of water are pumped from mines in the anthracite fields each day and nearly as much from the bituminous fields. It is estimated that these waters and the discharge from the washeries carry more than 3,000 tons of free acid and acid salts each day. How much coal is carried into the streams cannot even be estimated, but it is sufficient to obstruct the normal flow channels of the rivers, cause blockage of sewer outlets and increase flood damage during high-water periods over a considerable part of the state. The increasing hardness of the stream water adds materially to the difficulty and expense of maintaining at least 96 public water works in the state, supplying nearly 45 per cent of its total population. Altogether it is estimated that the cost of such pollution to the state is more than $8,000,000 annually.

Much of the coal washed into the streams is being reclaimed by means of small suction dredges which discharge the mixed sand, mud and coal over a screen having 6 or 8 meshes to the inch, which separates the sand and mud and the finer particles of coal from the larger size coal, which is marketable. It is estimated that about 2,000,000 tons of coal were thus reclaimed in 1920. Within the past two years several plants have been installed at mines for recovering the fine coal by sedimentation and neutralizing the acid water by lime treatment, thus rendering the mine water suitable for use in the breakers.

"Within the past few years various government departments and bureaus and the scientific staffs of large industrial establishments throughout the world have undertaken comprehensive studies of methods of disposal of many industrial wastes." The object of these studies has been two-fold—to recover products of value from the wastes, and, where this is not possible, to develop some economical process for modifying the waste so as not to prevent any legitimate uses of the receiving body of water."

From the progress already made "it appears that the creation of nuisance in streams and the destruction of their usefulness through lack of proper disposal of industrial wastes has passed the peak, and that in a few years such improvements in the general condition of the surface waters of our industrial states will be obtained that they can be economically used for all legitimate purposes."

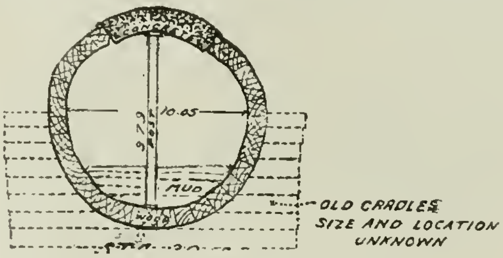
Muddy River Sewer

Replacing wood stave sewer in Boston by concrete sewer built in open trench, served by cableway and traveling gravity concrete mixer.

The old sewer in Brookline avenue, between Beacon street and Audubon road, Roxbury, Boston, consisted of an ancient cylindrical sewer, 10.05 feet in diameter inside, that was originally made with 4 x 12 inch wooden staves, from 15 to 20 feet long, lying in timber cradles a considerable distance apart in the clear. The cradles consisted of a number of courses of horizontal timbers reaching up to the spring line and probably serving as temporary plates for the assembling of the inverts when the sewer was built. The sewer was partly filled with soft mud and sediment and had at some time been partly rebuilt by removing a number of the staves in the crown that had probably decayed, and replacing them with a concrete arch segment or key about 3 feet wide that in some places was supported by vertical shores at the center point. The condition of the old sewer was so bad that it was considered dangerous, the roof had fallen in in some places causing settlement in the street above, and it was determined to replace a portion of it with a reinforced concrete sewer.

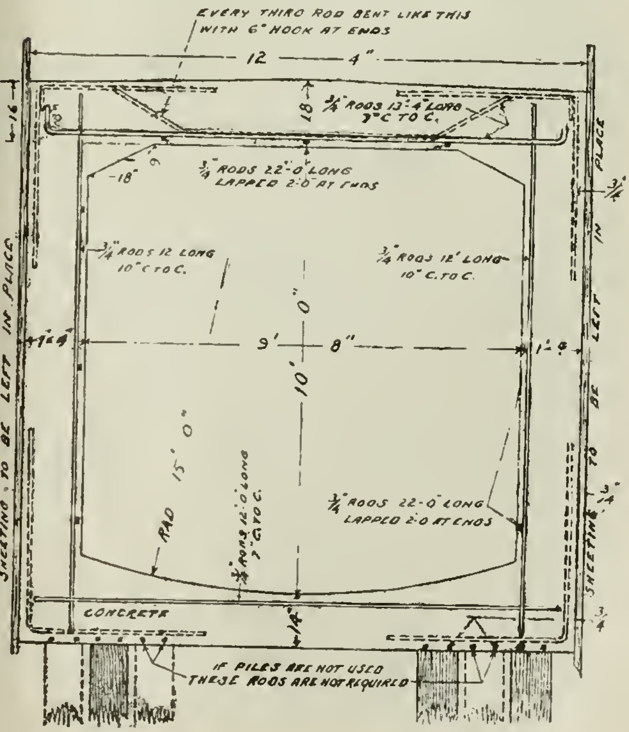
The new sewer 2,300 feet long has a rectangular cross section with a flat roof slab 18 inches thick, and an invert 14 inches thick at the center with a horizontal lower surface and the upper surface curved to a radius of 15 feet. The official design indicated that 6 rows of foundation piles, 3 rows on each side of the center line, were to be used for its support if necessary.

The new sewer received all of the flow of the old drains that carry surface water only, besides being provided at intervals of 20 feet with 6-inch and 8-inch pipe connections on both sides. The alignment coincides substantially with that of the old wooden sewer, which, with some other substructures that existed under the street, are entirely removed for the construction of the new conduit. The alignment is at a tangent and very light grade and passes, near Newbury street, under a set of five tracks of the Boston & Albany Railroad, the top of the sewer coming close to the subgrade of the track depressed in the cut. The samples recovered by the test borings along the line of the conduit, and carried down several feet below subgrade, indicated that the soil consisted of ashes, mud, peat, sand and gravel down to a considerable distance below ground water line, which is below the bottom of the sewer trench; indications that were verified as the excavation progressed.



OLD STAVE SEWER WITH CONCRETE CROWN

The contract was awarded to the C. & R. Construction Co., Boston, B. S. Kelley, superintendent, and work was commenced in July, 1920, and was about 70 per cent completed July 1, 1921. A 400-foot cableway, supported on wooden A frames, was installed over the center line of the conduit at one end, and is operated by a steam driven hoisting engine. One end of the cable is anchored to a deadman and the opposite end is anchored by a stone pile 4 feet high, built on a 15 x 18-foot platform, mounted on sills to facilitate the movement when the cable is shifted, an operation which occurs about once in two months and puts the cable out of service for three or four days.


EVERY THIRD ROD BENT LIKE THIS WITH 6" HOOK AT ENDS
12 — 4"
18
3/4" RODS 13'-4" LONG 7" C TO C.
1/4" RODS 22'-0" LONG LAPPED 2'-0" AT ENDS
-18"
9"
16
3/4" RODS 12 LONG 10" C TO C.
3/4" RODS 12' LONG 10" C. TO C.
10'-0"
9'-8"
1'-4"
1'-4"
15'-0" RAD
3/4" RODS 12'-0" LONG 7" C TO C.
3/4" RODS 22-0" LONG LAPPED 2-0 AT ENDS
CONCRETE
14"
IF PILES ARE NOT USED THESE RODS ARE NOT REQUIRED
SHEETING TO BE LEFT IN PLACE
SHEETING TO BE LEFT IN PLACE
3/4
3/4
3/4

NEW CONCRETE SEWER BUILT IN OPEN TRENCH

The excavation, being entirely above ground-water level and in fairly loose open soil, is handled wholly with pick and shovel and the soil is hoisted in 1-yard steel buckets, operated on the cable and generally moved to the rear and deposited in back-fill without rehandling. The concrete construction follows close to the excavation so that an average of only about 70 feet of trench is usually left open at one time.

The deepest cut is 35 feet and the sides of the trench are sheeted with the wooden staves recovered in excellent condition from the old sewer. They are driven by hand with heavy mauls as the excavation progresses, and where it is very deep they are placed in two or three successive tiers, and are braced by five sets of 6 x 6-inch transverse braces. Old 8 x 10-inch timbers from the contractor's stock are used for rangers. Where the trench is shallower, fewer tiers of braces are required. The surface water entering the trench, and the flow of the old sewer are pumped out with a 6-inch centriugal pump operated by electricity and discharging directly through an adjacent sanitary sewer.

Concrete materials delivered by automobile trucks are stored on the macadam surface of the street alongside the sewer and are mixed in a Haines gravity machine, mounted on a 15 x 15-foot moveable platform spanning the open trench that travels along as the work progresses. The lower hopper of the mixer is suspended by chains from the platform and when the latter is moved can be swung aside to clear the bracing underneath.

The old macadam stone removed from the street in the top of the sewer trench, is removed by tilting buckets operated on the cableway that dump it on an elevated platform from which it is shoveled on both sides to inclined screens about 8 feet long. The dirt passes through the screens and moderately clean stone and gravel are deposited in piles on the ground and are then removed, for sale or for use on the work, by automobile trucks. The work is being executed by an average force of about 45 men working one 8-hour shift daily. The estimated cost of the job is about $250,000.

The Rat Menace

The menace of the rat as a carrier of disease was dwelt on with some emphasis by Edward A. Goldman, in charge of biological investigations for the United States Department of Agriculture, in a paper before the American Public Health Association. He stated that while the best-known rat-transmitted disease, bubonic plague, has caused the death of millions of people since the beginning of the Christian era and is ordinarily transmitted by fleas that have become infected from rats, these animals have also been known to have been involved in the transmission of trichinosis, infectious jaundice and rat-bite fever.

"Under ordinary conditions, rats tend to keep pace in numbers with the increase and congestion of the human population, an aggravating modern factor. Unless house rats are controlled, the probability of the establishment in America of plague centers very difficult to eradicate, and from which epizootic outbreaks would lead to wide spread human mortality, seems reasonably certain."

Rats multiply very rapidly. Ordinarily there will be from three to five litters a year averaging ten to a litter. On the assumption of only three litters a year with an average of eight to a litter and with no deaths, calculation would show a progeny in three years of nearly 4,000,000 individuals. The mortality rate obviously must be high or rats would soon literally overrun the earth.

The elimination or control of the rat pest involves both the destruction of rats and the elimination of places inviting their living and breeding. For destruction, the author recommends a type of snap trap that will be sprung by a rat in passing and catch the animal regardless of whether it is attracted by bait. Under proper supervision, poisons may be used to advantage, and it has been suggested that heavy gases, such perhaps, as some of those developed during the war, may be used for killing them in their holes. Rubbish piles, especially when they contain garbage or other matter that would serve as food for rats, form especially inviting habitations and are frequently occupied by thousands of these rodents. If all such rubbish piles could be eliminated a very high percentage of the rats in this country probably would be deprived of homes and the numbers would rapidly decrease. "No garbage or trash piles should be allowed to accumulate in the vicinity of stores, markets or human habitations, and loose material should be kept cleared away as far as possible. The rat-proofing of structures should precede or at least accompany all rat-killing campaigns.

"In one of our great army depots in France, millions of dollars' worth of supplies attractive to rats were stored in temporary structures, where, under stress of war conditions, rat proofing was out of the question; but from the beginning the policy was adopted of keeping the ground as clear as possible in and about the buildings and of turning over at intervals the great stacks of food supplies. This depot was located in the interior of the country with no heavily infested area near, but the district was well settled and rats in usual numbers were living about neighboring farms. A few, as might be expected, entered the depot of their own accord, and others were carried in with freight shipments from the base ports and in carts returning from the front. Although food supplies were easily accessible, the number of rats gaining a foothold in the depot was almost negligible. The importance of eliminating rat harborage was strikingly demonstrated."

Boston Municipal Fire Boats

The three new steel fireboats for the Public Works Department of the city of Boston are 57 feet wide, 174 feet long, and 9 feet deep, with a displacement of 650 tons. They cost $400,000 each and are equipped with a 2½-inch fire nozzle under 150 pounds pressure at each end of the boat. They are equipped for burning coal, but can easily be changed to burn oil fuel.

Construction Questions Answered

How to Handle and Erect Bridge Girders Without Special Equipment—II*

By cribbing, jacking, rolling and skidding.

In the absence of the ordinary steel erector's equipment, even of derricks, it is possible to unload and erect large girders with no other equipment than ordinary jackscrews, timber blocking, and skids or rollers

If the girders are for a crossing not previously spanned and are delivered at bridge grade, they may be erected by protrusion in a manner similar to that described on page 393, May 7, or on page 78, July 23, or by some modifications of this method, in which case the girders are generally erected in pairs, often fully braced together to form complete spans, before they are seated in their permanent position.

CONTINUOUS GIRDER PROTRUSION

If the bridge consists of more than one adjacent spans, all of them may be successively assembled at grade in the axis of the bridge on shore beyond one abutment, and the first two spans, properly connected together to resist cantilever erection stresses, may be rolled out longitudinally until the forward end of the first span rests on rollers on the first pier, after which another span can be added to the rear of the second span and the three connected spans, really thus forming a continuous girder structure, advanced until the first span rests on the second pier and so on, adding the successive spans at the rear until the first span reaches the last abutment and all spans are above their respective substructures and can be lowered to permanent position and the rollers removed.

If the height above the ground is small and especially if obstructions are permissible between the piers, a falsework of framed trestle bents, usually about 16 feet apart, or of cribbing, built up to the required height, can be constructed and longitudinal timbers placed on it forming stringers carrying a floor on which the spans or girders may be rolled to position, lowered to place, and the falsework successively removed from span to span in advance of the erection.

If the girders are delivered at low level they may be placed as close as possible to the ends of the piers and abutments, parallel with the bridge axis and gradually raised up to the required height by jacking under each end and cribbing, blocking and wedging to follow up closely. At the required elevation they may be lowered to bearing on rollers on transverse skids and pushed, perpendicularly to their axis, to the required position on the bridge seats of the substructure. If it is not convenient to raise them clear of the ends of the piers or abutments they may be skewed so as to clear the faces of the substructure, jacked and cribbed to the required elevation clear of the substructure, skewed back parallel with the bridge axis, moved transversely, and lowered to position as before.

UNLOADING BY CRIBBING AND SKIDDING

If the girders are delivered on cars they can be unloaded by jacking up each end sufficiently to release the blocks on which they are supported during transportation and substituting for them the ends of greased rails transverse to the girder to serve as skids to which the girders are lowered by a very slight operation of the jackscrews. The skids must project far enough beyond the side of the car to carry the girder to a position clear of the car and their overhanging ends must be thoroughly supported on cribbing or some other kind of falsework. After the car is unloaded it can be removed, and if the girder is supported on the cribbing the latter can be removed piece by piece, as the timbers are released and the girder lowered by jacking at both ends. If the girder is to be shifted a considerable distance transversely, it can be done by pushing it from the horizontal to inclined skids, well supported on heavy timbers and cribbing, and lowering it down the skids by gravity, great care being taken to safeguard it by means of snubbing ropes attached to each end, with one or more turns around suitable anchorages on the upper side of the girder. Several snubbing ropes must be provided in accordance with the weight of the girder, the steepness of the incline and the number of men to operate them. It is preferable to have the incline not steeper than 1 in 6 nor flatter than 1 in 12, so that the girder can be easily handled on it with pinch bars and the snubbing lines.

If the girders are very heavy and the number of jackscrews is limited or their capacity small, it is possible to handle it more slowly and laboriously, by providing two fulcrums, one near the center on each side, and rocking the girder alternately from one fulcrum to the other by means of the jackscrews at the opposite ends, assisted, if necessary, by a number of men walking to the opposite end of the girder and helping to balance it. By this means a very short lift blocked up with thin pieces of timber, bars or wedges, can be made with every oscillation, and the girder raised or lowered simply by shifting the fulcrum, which can even be done by shifting the counterweight without the use of jackscrews.

DELIVERY AT SITE AT GRADE

If the girders are to replace an old span already supported on the same substructure, it will often be possible to deliver them and unload them from the old bridge, move them out transversely to positions far enough away from the center line to permit traffic to be carried on between them and then to lower them clear of the old structure and replace the old floor with the new, piecemeal without much delay to the traffic. It will be quicker and safer, however, if the traffic can be diverted for a short time after the girders are in position, enabling the old superstructure to be entirely removed and the new to be built without regard to traffic.

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*Transportation to site and erecting by protrusion was published July 23.

If the old bridge is not strong enough to safely sustain the weight of the new girders while they are being carried across it, the latter may be supported on rollers at two points, one at the forward end and the other ¾ of the distance to the rear end. The latter roller will carry a much larger portion of the load, thus relieving the forward roller and the bridge floor under it until the girder is three-quarters of the way across the span, when the rear end may be jacked up on shore and the rear roller moved back to the end, thus increasing the load on the forward roller when it is near the farther abutment and will produce much less strain in the old trusses or girders than in the center. It is also possible, in many cases, to shore up the girders, floor beams or stringers of the old span temporarily while the new girders are moved across it and as soon as they are in the proper longitudinal position their ends can be supported from the substructure, releasing the old superstructure.

MAINTAINING TRAFFIC DURING ERECTION

If the traffic cannot be by-passed or detoured, and it is necessary to maintain it without interruption and if the new girders cannot be erected and the span assembled on the substructure while traffic is maintained on the old superstructure the required results may be accomplished by building falsework parallel and adjacent to the old superstructure on both the upstream and downstream sides. On one of these falseworks the new span may be assembled complete and finished ready for use in the proper elevation and longitudinal position and as close as possible to the old superstructure. Both old and new spans can be slightly raised and live rollers placed under them between upper and lower track rails, reaching from out to out of the two sets of falsework, and supported between them on the piers or abutments or on single bents of falsework adjacent to them. The traffic can then be stopped for an hour or two and both bridges moved transversely on the rollers until the new superstructure replaces the old and receives the traffic, being lowered to position and permanently seated as quickly as possible, while the old superstructure can be removed at leisure. Very short, light spans can be jacked transversely on greased skid rails without the use of rollers.

TRANSVERSE DISPLACEMENT OF MULTIPLE SPANS

An excellent illustration of the transverse displacement method above described is that which was adopted for the erection of the 12-span riveted truss bridge across the Wisconsin river at Merrimac, Wisconsin, which, although a railroad bridge, was handled exactly as a highway bridge might have been in a similar location.

Falsework was erected on both sides of the spans of the old structure and on one line of falsework three spans of the new superstructure were riveted up complete.

Hoisting engines and tackles were available by which the old spans were pulled out onto the opposite falsework in three minutes, the tackles shifted and the new spans pulled into the position formerly occupied by the old ones and lowered 15 feet in about five minutes each, the average time for replacing the span ready for traffic being about two hours.

After a set of three new spans was erected, long transverse beams overhanging both sides of the structure were mounted on cars, two bents of falsework hoisted from each end of the beams, balancing each other, and carried forward to the next old span in advance where they were seated and braced together to form a stable tower, and the remainder of the falsework shifted the same way, ready for the erection and transportation of the next span, and so on.

BINGHAMTON BRIDGE

The Court Street highway bridge at Binghamton, consisting of four half deck spans with three 85-foot Howe trusses each, was replaced by four plate girder spans of the same length, each consisting of five girders 7 feet deep. These were shipped singly, loaded flatways on two end cars with a spacer between.

They were jacked up on the cars and skidded off to rest on two ordinary heavy wagons from which the reaches had been removed and each replaced by three 8 x 8-inch timber 12 feet long, bolted to the axles of each wagon. Across the centers of these timbers were set 8 x 8-inch bolsters pivoted in the center to the middle timber to revolve on short bearing pieces of iron on tops of the timbers.

The girder was loaded so that the bolster of the forward wagon was 12 feet from the front end of the girder and that of the rear wagon 20 feet from the rear end, leaving a space of 52 feet between bolsters. The bolsters were about 9 feet long and had 1 1/3-inch iron pins driven through their ends to secure the girder from slipping sidewise.

Six horses were attached to the front wagon and two men walked underneath the girder steering the rear wagon by its tongue. The girders were carted half a mile to the bridge site and jacked off from the wagon to blocking from which they were gradually lowered to the ground to rest flatwise on eight 3-inch solid iron rollers 10 feet long running on 6 x 12-inch stringers.

They were rolled out to approximate position on the deck of the bridge on this track and were then revolved into a vertical position by a heavy tackle suspended from gallows frame set on the top chord of the old trusses. They were then removed on transverse greased rails, their transverse bracing assembled, and lowered to final position in the manner best suited to the removal of one half of the old structure, while the traffic was diverted to the other side of the bridge, which was later replaced in a similar manner, while traffic was maintained on the first longitudinal half of the new superstructure.

Recent Legal Decisions

CITY NOT BOUND TO PROTECT TROLLEY POLES RIGHTLY IN CENTER OF STREET BY GRASS PLOTS OR CURBING

In an action against a city and a street railway company for injuries to a passenger in an automobile resulting from contact with a center pole in a street supporting trolley wires, the New York Appellate Division holds, Wegmann v. City of New York, 186 N. Y. Supp. 893, that the company, being authorized by the state to operate on overhead trolley, could only be held liable if the pole was not placed with due regard for the public safety, and, the evidence showing that without the pole there would be the danger of breakage of the span wires, on a span of 120 feet, bearing four wires charged with a high-voltage electric current, which would then be thrown into the street, there was no proof that the choice of place by the company was unreasonable. The plaintiff claimed that there should have been grass plots or other curbed spaces around the pole. It was, however, held that there was no obligation of either the city or the company to make a more extensive appropriation of the space of the plaza where the pole was erected to the use of the trolley companies than was necessarily required for such use. The court said: "If a person would run into a trolley pole extending 22 feet in the air, with a 4-foot white band painted on it at the height of the eye, hence directly in the line of vision, would greater safety be assured by a grass plot or a 4 or 6-inch curb surrounding the pole?" Judgment for the plaintiff is reversed and the complaint dismissed.

IMPLIED POWER OF CITY TO SELL HEAT AS A BY-PRODUCT OF ITS LIGHTING PLANT

A city cannot operate a heating plant until it is legally established, but the use by a city of exhaust steam from its legally established lighting plant to heat city buildings and the sale of some of the heat service to private individuals is not within Iowa Code, par. 720, requiring authority from the electors to establish such a plant. N. E. Burkitt Motor Co. v. City of Stuart, Iowa Supreme Court, 181 N. W. 762. The subject matter of the contracts with the private consumers was the sale of a by-product that otherwise would be a waste. The city has the right to heat its own municipal buildings, and in so doing requires no franchise from the electorate. "The power of a city to dispose of its by-products resulting from the legal operation of its municipal agencies is necessarily implied and incidental to powers expressly granted. A city may sell and contract for the sale of the ashes resulting from the operation of its steam plant, or the dirt, coal, or rock taken from its streets in the improvement thereof, or manure from its barns, or the grease and refuse from its incinerating plant. True, the city may not engage in an independent business. In such case the doubt is resolved against the delegation of such power, and no power by implication arises unless it is indispensable to the powers expressly given. . . . The sale of a by-product by the city bears no relation to taxation except to lessen the burden thereof by securing revenue from sources that otherwise would constitute waste."

CONTRACT FOR DELIVERY BY INSTALLMENTS WITH POWER TO CITY TO REFUSE TO ACCEPT FURTHER DELIVERIES LACKS MUTUALITY

The Georgia Supreme Court holds, National Surety Co. v. City of Atlanta, 106 S. E. 179, that where, in response to an advertisement by a municipality for bids for the furnishing and delivery of coal for a period of twelve months, a bid is made to furnish a specified number of tons, and a contract is afterwards entered into for the delivery of so many tons per month at a given price and at a stated place, but it is expressly stipulated in the contract that the purchaser shall be at liberty at any time by a written notice to order a suspension of deliveries of the coal and to refuse to accept further deliveries, the element of mutuality is wanting in the contract. Orders subsequently given by the purchaser for deliveries of a portion of the quantity included in the bid will not render the contract binding upon the bidder, even for the delivery of the portion thus ordered. This is not an acceptance of the bid as made. There being no contract binding upon the principal, the bond for performance was not enforceable against the surety.

TOWN WITH PRESCRIPTIVE RIGHT TO DIVERT WATER MAY ENJOIN DIVERSION BY UPPER OWNER

The Supreme Court of Appeals of Virginia holds, Town of Gordonsville v. Zinn, 106 S. E. 508, that a town which owns only an acre of riparian land, but which, by its adverse collection, dominion and control of all the water of the stream which flowed down to its said lot for longer than the prescriptive period, has acquired by prescription a substantial right against all lower riparian landowners, and hence a vested right, to the exclusive use of the water to that extent, may enjoin an upper owner from withdrawing the water in such quantity at any time as will in any degree diminish the quantity of water which the proof may show that the town has by prescription acquired the right to divert for its daily supply.

INTEREST ON BOND OF CONTRACTOR FOR PUBLIC WORK NOT RECOVERABLE WHERE SUCH IS LAW OF STATE WHERE CONTRACT MADE

In an action by the United States on the bond of a contractor for public work, given under the federal statute, for the fulfilment of the contract, the federal district court for the district of Delaware holds that where by the law of the state where the contract and bond were made (in this case North Carolina) no recovery can be had in excess of the penalty in a penal bond, interest on such sum is not recoverable. United States v. Garland, 271 Fed. 14.

NEWS OF THE SOCIETIES

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference. Hotel La Salle, Chicago, Ill.

Aug. 23-25—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS Annual meeting. Detroit, Mich. Secretary, Emmet P. Grifhn, Superintendent of Park, East St. Louis, Ill.

Aug. 30-Sept. 1—MICHIGAN STATE GOOD ROADS ASSOCIATION. Annual meeting. Flint, Mich.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 5-7—SOCIETY OF INDUSTRIAL ENGINEERS. National convention. Springfield, Mass.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F, Morgan. Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

NATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS

The second annual conference of this association will be August 10, 11 and 12, at Chicago, during the "Pageant of Progress" to be held by Chicago during August. Headquarters will be at the Hotel La Salle. There will be a conference with a luncheon at the hotel on Wednesday noon and a beefsteak supper at another hotel on Wednesday evening. The annual banquet will be at the La Salle on Thursday evening. Conference sessions will be called for Wednesday afternoon and both morning and afternoon on Thursday. There will be no formal papers but round table discussions of questions will be brought up by those present.

THE NATIONAL ASSOCIATION OF BUILDERS' EXCHANGES

According to a statement of I. E Sprankle, state commission for the National Association of Builders' Exchanges in Ohio, every city and town in America of 10,000 population should have an exchange with which smaller rural communities should be affiliated. The state should have a separate state organization that should be a member of a national organization, the rules and regulations of the different exchanges and their combinations should be standardized.

The exchanges should function in legislative matters, including taxation and all matters of city or national nature. Among the important subjects that require their attention is the tax imposed in many states upon real estate investments, banking laws discriminating against building business and other laws and rulings by which money is driven from real estate investments to other channels.

THE MINNESOTA STATE BOARD OF REGISTRATION

The State Board of Registration for Architects, Engineers and Surveyors, just appointed by Governor J. A. O. Preus, of Minnesota, is composed of F. W. German, architect, Duluth; H. T Downs, architect, Minneapolis; A. F. Gauger, architect, St. Paul; F. W. McKellup, civil engineer, Faribault; D. E. Woodbridge, mechanical and mining engineer, Duluth; Paul Doty, mechanical engineer, St. Paul; and N. Y. Taylor, land surveyor, Litchfield.

All architects and engineers in the state must have six years of acceptable study or experience and take out a $25 license and $10 yearly renewals.

TRADE PUBLICATIONS

SULTAN CONTRACTORS' EQUIPMENT

"Modern Road Building and Maintenance," just published by the Hercules Powder Co., has been prepared for the use of engineers, contractors, road officials, students and all who are interested in the rational and economic solution of the many problems connected with our public roads and traffic they are required to carry. The book was written by Andrew P. Anderson, highway engineer of the Bureau of Public Roads. It contains chapters on Planning the Road, Road Materials, Road Construction, Road Maintenance and Repair and Use of Explosives. A copy will be sent free to anyone making a written request to the Hercules Powder Company, Wilmington, Del., or to any of the branch offices of this company.

TEXACO ASPHALTIC CONCRETE

A Texaco asphaltic concrete wearing surface is made up of stone, sand, mineral filler and Texaco asphaltic cement. The steps in constructing a Texaco asphaltic concrete wearing surface are as follows:

1. Measure the stone and sand in the proper proportions and then mix them. After this heat the stone and sand to a temperature of from 325 to 350 degrees F. This is done in a heater or dryer.

2. At the same time, heat the asphaltic cement to the same temperature in a heating kettle.

3. When the stone and sand are brought to the proper temperature dump them into the mixer. Then add the proper proportion of mineral filler, which may be either Portland cement or limestone dust. After this is done, dump the proper proportion of asphaltic cement into the mixer, which has already made a uniform combination of the sand, the stone and the mineral filler. Then continue mixing until the particles of mineral aggregate are thoroughly coated with asphaltic cement and a homogeneous mixture is produced.

4. Dump it into a wagon or truck and convey it to the street or roadway to be paved. By the use of canvas covers or tarpaulins, the material may be hauled a long distance with little loss in temperature.

5. Dump it on the foundation and shovel it into place. Comb the material thoroughly with hot rakes as it is being deposited and smooth it to an even contour. Spread enough material to give the desired thickness.

6. Tamp the hot material along the curb or gutter and around all manholes, covers, valve boxes, etc., with hot iron tampers.

7. When tamping has been completed roll the newly laid pavement with a heavy self-propelled roller, first longitudinally and then diagonally.

8. After maximum compression has been attained by rolling, cover the surface of the pavement lightly with cement or limestone dust. The pavement is then ready for traffic.

(Excerpt from booklet sent free on application to Texas Co. Asphalt Sales Department, 17 Battery place, New York City.)

PERSONALS

Smith, Herschel C., formerly deputy state highway engineer of Oklahoma, has been appointed assistant professor of highway engineering and highway transport at the University of Michigan.

Welborn, M. C., division engineer with the Texas State Highway Department, has resigned to become city engineer of Paris, Texas.

Turner, Arthur J., for the past two years chief engineer for the Columbia Basin survey commission of the state of Washington, resigned that office on June 1 to become superintendent of construction on the Skagit River power project being carried out by the city of Seattle.

Leonard, O., has resigned as county engineer of Parker county, Texas, to accept a similar position with Travis county.

Middleton, Ellis G., has resigned as village engineer of Le Roy, N. Y., to accept a position with the highway commission of West Virginia.

McGrath, J. K., for the past five years county engineer of Fayette county, W. Va., has resigned to accept a position as division engineer with the state road commission, to have charge of the state roads in Kanawha, Clay, Fayette, Boone, Nicholas, Raleigh, Summers, Monroe, Greenbrier and Pocahontas counties.

Hagis, A. B., has been appointed city engineer of Jellico, Tenn.

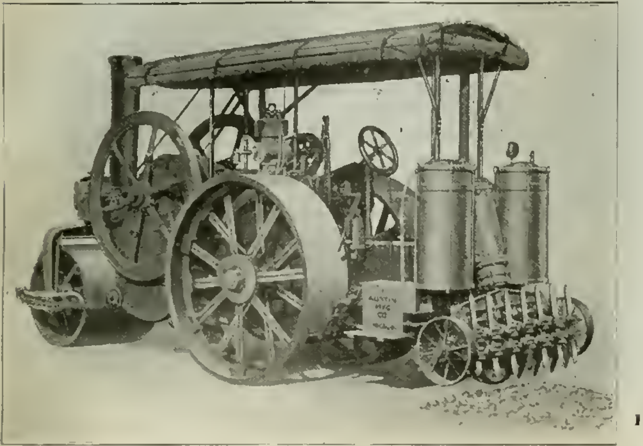
Harrington, W. H., has been appointed city engineer of Tracy, Cal.

Dryden, F. H., has been appointed city engineer of Salisbury, Md.

Wamsley, Judson, has resigned as county superintendent of roads of Montgomery county, Pennsylvania, and William Redington appointed superintendent of highways for the same county.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



MOTOR ROLLER WITH SCARIFIER

MOTOR AND STEAM ROLLERS

The handsome new Catalog F issued by the Austin Manufacturing Co., illustrates several types of improved road rollers with special reference to the latest advance in the development of a type operated by gasoline motors. They are made in 7, 8, 10, 12 and 15-ton sizes equipped with 4-cycle horizontal engines. Single cylinder engines are standard for the three-wheel rollers and double cylinder engines for the tandem rollers.

The three-wheel macadam type has ample power, can be started with a few minutes' preparation and runs many hours without requiring to stop. It can be operated either with kerosene, gasoline or lamp oil, carries a large supply of fuel, and requires only a small amount of water. It has a variable speed regulator and two positive gear changes, giving it very elastic speed for road travel. It has a reliable hand steering device, which, on very heavy rollers, can be replaced by power steering mechanism.

The Austin steam roller is especially recommended on account of the proper width of tread and distribution of weight and because it has 20 per cent more boiler heating surface than other standard steam rollers, thus making it especially efficient for rolling subgrade and macadamizing on hills and for scarifying and other heavy demands.

It can be provided with a scarifier attahcment having seven teeth that will tear up a strip of road about 5 feet wide at a trip. These are mounted on a frame that is raised or held down in position by air pressure.

The tandem motor roller is superior to the three-wheel roller because it is steadier running, has lower central gravity, higher road clearance, easier control, quicked and more elastic power steering and less operating costs. It is made in 5, 6, 7 and 8-ton sizes.

The same company makes an independent steerable scarifier weighing 6,400 pounds that can be hauled by a road roller and instantly detached.

The other road machinery manufactured by the Austin Co. and sold by the Austin Western Road Machinery Co., includes graders, dump wagons, stone spreading wagons, elevating graders, street sprinkler, several types of street sweepers, a two-speed sprinkler-sweeper, a pressure road oiler, a gyratory crusher and mammoth graders and road rippers.

DIPPER DREDGES

Dipper dredges, manufactured by the Bucyrus Co., have been on the market since 1883 and are said to outnumber all of the other high-powered dipper dredges in the world. They are used to advantage for widening, deepening and maintaining harbors, rivers, canals or ditches and for general submerged excavation on construction work and will dig harder and bulkier material than any other dredge. The bail of the large size dredges has a maximum pull of 250,000 pounds, which can be concentrated on a single tooth and enables it to dislodge and handle very large stones, trees and other obstructions.

The use of the dipper dredge is recommended for scow loading of excavated material, depositing spoil on adjacent banks, heavy digging, handling large or medium sized stones, handling material that requires blasting and dling material that contains sunken timbers or fallen trees.

Each dredge is designed to meet the requirements of the work under contemplation, and may be built in accordance with the specific information furnished in reply to a printed list of questions issued by the manufacturer.

The main engines may be twin tandem compound or double cylinder type and are usually made reversible with Stevenson link motion. The large engines are made non-reversible and the small engine is gear connected to the crank shaft to reverse the drum. On most of the smaller dredges the backing and stern drums are driven from the main engine on the larger engines the hoisting shaft carries a friction clutch designed for operation from the same thrust cylinder.

The backing machinery for the larger dredges consists of an annealed steel casting drum, which is gear driven from a double cylinder engine. The swinging machinery consists of a machine grooved drum keyed to its shaft from a double cylinder reversible engine. Two sets of machinery are provided for hoisting the spuds. The stern spud machinery for the larger dredges consists of an independent unit with rack and pinion gear driven from a double cylinder reversible engine.

The structural steel boom is of the double-bow lattice of plate girder type with annealed steel foot castings. The shipper shaft is mounted in cast steel bearings at the center of the boom and is fitted with two pinions and two brake wheels. The dipper handle is composed of two timber members heavily armored on all sides with steel plates.

The heavy reinforced dipper may be of plate or cast steel and has a pin connected forged bail and a heavy plate door with latch keepers and forged steel hinges. It is provided with four forged steel teeth or a forged steel cutting lip. The swinging circle is mounted on an annealed steel casting that is rotated on the pintle of a heavy base plate. The A-frame legs are pin connected and guyed with wire rope. The dredges are designed to be operated either by steam or electric power, and the levers by which one man can control the principal operations are located in a position that affords the best view of the work.

The circular illustrates the three 15-

34 MEN STANDING ON PLATFORM SUSPENDED IN 15-YARD DIPPER BUCKET BUILT FOR BUCYRUS DREDGE ON PANAMA CANAL

yard dipper dredges purchased by the United States government for Panama Canal work, that are equipped with 6 x 28 x 24-inch engines and are designed to dig to a depth of 50 feet, and were operated at 45 seconds per cycle. One of them lifted a 50-ton boulder, which had to be blasted three times while resting on the dipper. Illustrations are also given of other dredges up to 15-yard capacities and hydraulic dredges with 12 to 28-inch suction pipes.

FONTAINE DEMOUNTABLE TRUCK BODIES

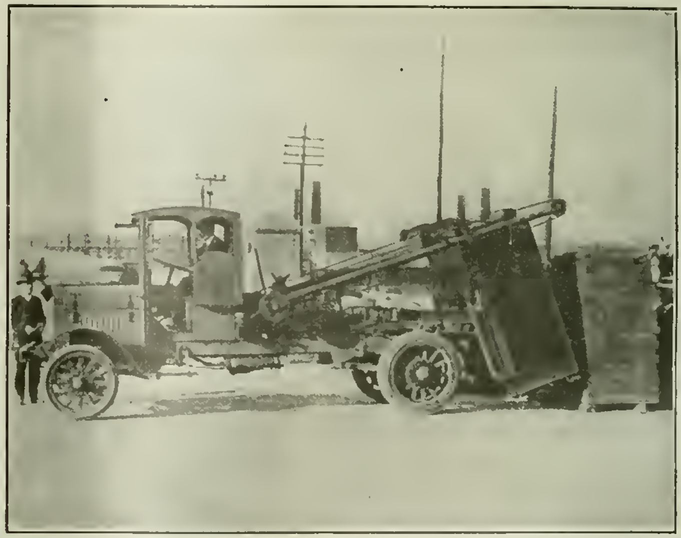
These bodies are manufactured by the American Truck Body Co., Inc., in three types especially designed for the rapid and safe unloading of 1,000, 1,500 and 2,000 brick stacks handled on pallets. They are made of 3/16-inch reinforced riveted steel plates and can easily be installed on any standard truck to which they are attached by U-bolts.

The equipment, which has several improvements over previous models, consists of a frame, with power hoist, cradle and two detachable bodies with pallets. The cradle moves back and forth on the frame in such a manner that the body may be set on the ground and then carried back on the truck in the proper position for hauling. The body is not lifted as a dead load, but is simply pulled over the arc of a circle, making it easier to handle the load. The hoist is sufficiently strong to handle the load with perfect ease, and is so made that it is self-locking so that the load may be held in any position desired. The power to operate the hoist is derived from the power take-off of the truck. If the "Fontaine outfit" is placed on an old truck, which does not have a power take-off, the power take-off can be obtained from the manufacturer.

The detachable bodies are held in place on the cradle by means of two lateral arms which securely hold a pipe on the body. It is impossible for the body to slip in any way whatever. When it is desired to detach the body, the equipment is lowered until the body is on the ground and then the arms pass under the pipe. The body cannot be detached while on top of the truck. The pallet acts as the tail gate of the body and is held in place by two iron pipes. When the load is deposited, these pipes are slipped out and the brick are left stacked on the pallet, when the truck is pulled away. The pallets are of rough wood construction and are left under the stack until the brick are used.

The Fontaine delivery system enables the truck body to be loaded at a convenient place. When loaded, the truck comes, picks up the loaded body, and carries it to its destination while the additional body is being loaded. The truck is continually on the go, and the time lost in loading and unloading is saved, the truck driver is the only man required to pick up the loaded body and deposit the load. When brick are dumped from a truck a large percentage are chipped and broken. But with the Fontaine equipment the brick cannot be broken. On a city street it is necessary that the brick be stacked, and this can be advantageously done first of all. As the body is packed to capacity, it is simple to check up on the number of brick delivered without counting them.

TRUCK BACKING INTO POSITION TO UNLOAD A STACK OF BRICKS



STACK OF BRICKS DEPOSITED ON GROUND, RELEASING TRUCK BODY THAT IS THEN RETURNED TO POSITION ON CHASSIS

TRUCK DRIVER UNLOADING STACK OF BRICKS QUICKLY BY POWER

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 AUGUST 6, 1921 No. 6

The State Highway System of Connecticut

Development and cost of state roads. Receipts from motor vehicles, amounts assessed on commercial motor vehicles. Rational control of truck traffic beneficial. Enforcement of traffic regulations. Classification of highways and revenue anticipated.

The most important development in the highway situation in Connecticut during the past six months has been the final establishment of the relations between the construction, reconstruction and maintenance costs of the state system and the financing for the same.

The situation a few years ago was one in which traffic considerations were almost independent of road engineering since the stone and gravel roads then constructed represented the highest class of roads and were more than ample for all of the then present or then anticipated traffic. With the advent of high-speed and high-powered motor vehicles, this has been entirely changed, and it has become apparent that substantially a new system of greatly increased road capacity of different construction types is required very largely in behalf of automobiles. These, therefore, constitute a favored class which should in equity bear a proportionate share of the burden entailed.

PROPORTIONING COSTS

By the use of official data, it has been possible to classify the cost of future construction and to a considerable extent, the proportion of deterioration due to the different classes of service; and from a study of these and other data of the State Highway Department, it became apparent that an enormously greater amount of funds was required immediately and continuously, and it appeared equitable to assess this to a very considerable portion of the automobile traffic. Considering the respective amounts and the importance of the pleasure and commercial traffic, the Highway Department assumed that an apportionment of two-thirds of the special automobile revenue might justly be derived from the pleasure cars and the remainder from the commercial cars.

Up to 1915 most of the motor vehicle fees received by the Highway Department were derived from pleasure vehicles and only a very small percentage came from motor trucks; but since that time the percentage of motor trucks registered has quadrupled, there has been a large outlay necessary for widening, strengthening and otherwise improving hard-surface roads, and concrete reconstruction of the principal lines of highways has cost from $40,000 to $60,000 per mile as compared with a maximum of $6,000 or $7,000 per mile for the macadam, stone and gravel roads that sufficed before the automobiles arrived.

This, of course, multiplied many times the expenditure of the Highway Department, which has increased to $6,000,000 or $7,000,000 annually, exclusive of the town, county and federal aid expenditures. This large sum can be raised by either a direct tax levy on all the people of the state, by bonding the cost of new construction, or preferably by allotting to the more direct beneficiaries of improved highways a just share of the cost of securing them, as was strongly urged after a careful review of the past, present and future conditions to be met by the state and its officers.

With this proposition, the Highway Department brought up the subject for legislative action, and, of course, encountered the expected violent opposition, but the arguments, reinforced by unimpeachable data, were so strong that the different committees were soon convinced and the question became one of amount and details of operation. The theoretical assessment, as computed from a consideration of the investment, the operation, the relative advantages to and the benefits derived by the five-ton motor trucks, indicated that a logical proportion might be derived by assessing them the unprecedented amount of $750 each per annum, but as this was manifestly impracticable, the request was reduced to a modest $450, and after a very thorough discussion and strong efforts, considerable practical success was achieved by accomplishing an actual imposition of $187.50 for a five-ton truck annually. The schedule of fees up to that point is in proportion. Beyond that point, the truck is practically prohibited.

The old fees, together with those provided by general taxation and other sources, have given during the current year a total of $6,000,000 which will be expended in the proportion of about $2,000,000 for maintenance, temporary work and repairs; $2,000,000 for reconstruction; and $2,000,000 for construction, including $700,000 for bridge work.

CONTROLLING ROADS AND TRAFFIC

Although the truck owners at first very naturally felt grieved at the increased tax, their attitude has been greatly modified and is due in considerable measure to the somewhat unusual and very successful system developed by the department during the last winter and spring when the roads were affected by snow and frost and rain, so that the heavy trucking service on them became not only more difficult, but in many cases threatened great injury to the roads. Recognizing this, the department legally closed certain roads, or portions of roads, routed the traffic through other parts of the system, and attempted to enforce a very careful restriction on loads.

This resulted not only in the saving of a great many thousands of dollars in possible damage which might have accrued through the injudicious use of the roads, but at the same time resulted in the maintenance of open traffic routes throughout the worst of the season and cared for all of the necessary business that had to be transacted. The truck owners did not fail to realize this, and as a whole have become appreciative and friendly to the system and its enforcement.

LIMITING LOADS

There is a regulation in the state restricting the load, including the weight of the truck, to 25,000 pounds, and the highway commissioner has the right, if he sees fit, to recommend the licensing of trucks in excess of that amount on certain specified routes. He may also, in his discretion, at certain seasons of the year, or on certain highways, restrict the loads.

Under the new law, which is a modification of the old one, he also is allowed to call upon the Motor Vehicle Commissioner, in connection with matters for the enforcement of these regulations at particular points, and the Motor Vehicle Department is working in co-operation, of course, with the Highway Department and attempting to enforce the laws. This co-ordination is achieving and promising exceptionally good results.

The Motor Vehicle Department has established at the state line in two places stations at which are located inspectors who are attending to the regulation of traffic and the restriction of loads. This has been quite a material help in cutting down the over-loading.

CLASSIFICATION AND MILEAGE

The state of Connecticut has 1,600 miles of state highways. In addition to this, there are about 10,400 miles of unimproved highways and probably 75 miles of concrete, a little of which is only 16 feet wide; practically all of it is 18 feet or more in width. There are about 100 miles of bituminous concrete which is eitner on a concrete base or on a stone base. There are about 50 miles of bituminous macadam and about 400 miles of macadam stone road which is treated superficially with bituminous material, and the remainder is either gravel or combinations of stone and gravel or stone and earth. Practically all are treated with oil, tar and calcium chloride.

Not more than half of new roads constructed will be concrete; possibly 35 per cent will be concrete or on a concrete base. The remainder will be selected from the other types according to local conditions and requirements.

It is assumed that there will be a falling off of the revenue derived from automobiles for the next few years. The increase has been 20 per cent for three or four years, and it may come down to 15 or 10 per cent. It has probably reached the steepest portion of its increase and will flatten out.

It is expected that the yearly revenue will be $3,000,000 from automobiles and $3,000,000 from other sources, and it is surmised that this amount will probably be the average expenditure of this department for the next few years.

Protecting Foundation Concrete from Running Water in Very Cold Weather

One of the piers of the United States Government Railway bridge over the Susitna river, Alaska, was built in an open pit, sheeted with Wakefield sheet piling and excavated by an orange peel bucket and by pick and shovel.

The excavation was in porous gravel and boulder foundation, through which considerable water penetrated under 25 feet head in the bottom of the pit, and it was considered impractical to deposit the concrete under water by tremie or bottom-dump buckets. The leakage in the cofferdam was eventually controlled by covering the bottom of the 33 x 69-foot excavation by a single large sheet of canvas that extended 6 feet vertically up on the walls of the cofferdam and was formed-in along the sides and ends, providing an exterior flume for the water, which was thus conveyed to the sump, from which it was removed by drainage pumps.

The cofferdam was roofed and steam coils around the edges were provided for heating the interior. Aggregate was dumped on platforms heated by perforated pipe coils and the concrete was mixed with hot water. The concrete was placed in temperatures as low as 12 degrees below zero, was conveyed from the mixer to the pier in pipes and chutes and was not allowed to come in contact with cold water until after it had set. The work was executed under the general supervision of Col. F. Mears, chairman and chief engineer of the Alaskan Engineering Commission.

State Highway Snow Removal in Connecticut

State roads cleared after every snowfall by department maintenance forces with plows and scrapers operated by motor trucks.

An act of the Connecticut legislature, passed in 1917, authorizing the highway commissioner to remove snow from trunk line highways, provides that:

> Section 1. The highway commissioner shall cause the removal of snow from any completed portion of any trunk line highway when the accumulation thereof shall render such highway unsafe or impassable for public travel. He may direct the selectmen of any town or officer having charge of such highways in any municipality to remove such accumulation of snow at the expense of the state.
>
> Section 2. Nothing in this act shall relieve the responsibility of street railway companies for the proper removal of snow from their track areas and without the obstruction of the traveled path of the trunk line highways."

The roads are kept clear with snow plows in front of trucks. In the deep drifts, after the truck has broken through, it has to be cleaned out. The Good Roads Machine Company's plows are used. The plow goes down one side of the road and back on the other side, clearing the road for the full width. Under ordinary circumstances one truck and plow will clear a 4-inch (average) snow fall, and will handle ten miles per day easily. The trunk lines are kept open, and state aid roads are not touched until trunk lines are open. About 3 inches of snow is left on the road, which permits runners to go until the first thaw.

NEW MILFORD-LITCHFIELD ROAD

WASHINGTON-LITCHFIELD ROAD

THE TRUCK AND TRACTOR OPERATING PLOW IN SILVER LANE ROAD

A soft, fresh snow fall up to 3 feet in depth can be penetrated by a 3-ton truck hauling a scraper. If deeper drifts are encountered, it is necessary to shovel or assist by a small tractor in advance that breaks a path for the truck, enabling the truck to remove the heavy snow in short successive operations. Only under serious conditions are tractors used.

The character of the truck work without motor or shoveling assistance is shown in the picture of Litchfield road, New Milford. A road that has been trimmed by shovel after scraping is shown at the Washington-Litchfield line.

When the snow is very compact or frozen, it is sometimes impossible to operate tractor, truck or scraper. In such cases it is plowed like clay. Ordinarily, inside of twenty-four hours roads are made passable. The gangs start out to work when the snow begins to fall.

In order to hold the truck down so that it will drive in the snow removal it is always necessary to load it heavily.

The High Cost of Poor City Pavements

By Clarence D. Pollock

A great deal has been said about the deplorable condition of our railroads and much attention has been given to the highways of the country, but city pavements have been left out of consideration to a large extent.

They had to be neglected during the period of the war. Very few, however, seem to have considered them since then, although they are a very great factor in the collection and distribution of freight. The condition of the city pavements is very important in the economical handling of construction materials and food products.

Pavements in bad condition add enormously to the cost of upkeep of vehicles, in addition to the slowing up of traffic. The city pavements may be compared to a terminal railroad, as they provide the means of distributing the freight from the trunk railroads as well as that hauled by trucks over the highways.

Anything that causes a slowing up of the street traffic causes greatly increased freight charges. The poor pavements cause less mileage per truck per day and in addition necessitate the consuming of a much greater quantity of gasoline. With the high price and scarcity of gasoline, this latter is by no means a negligible item. The gasoline item is not the largest item by any means, still it is a considerable one.

Another item is the wear and tear on the trucks and automobiles. With the high cost of labor and materials which enter into auto truck repairs, this is a large figure in connection with the cost of handling construction materials, and, in fact, all kinds of materials and supplies.

While it may be expensive to lay city pavements at the present time, it is more expensive to neglect them and pay the extra cost of handling freight and food supplies. This is a point that seems to be overlooked by the average taxpayer and city resident. A little more in taxes to provide good city pavements would, without doubt, be returned several times over in cheaper cost of supplies.

A great deal has been done by material handling concerns in the actual loading and unloading of materials and supplies by means of machinery, but this is largely nullified by the obstacles encountered in the city streets because of poor pavements. When a vehicle is stalled in a rut it not only delays that individual truck, but it obstructs part of the roadway and thus slows up the movement of all other vehicles in passing this point. This is a cost difficult to determine in dollars, but all truck owners know that it is a big item.

The taxpayers should realize this and try to impress the importance of good pavements, kept in good repair, upon their city officials. During the past year many cities started out with elaborate plans to replace their worn-out pavements which they were unable to keep in repair during the war period, but when bids were received, the prices caused them to reconsider and their programs were greatly curtailed. These cities continued to make temporary repairs to their worn-out pavements at great cost, but seem to have forgotten to consider the great cost to the vehicle owners and do not realize that this cost is in turn shifted to the citizens in increased costs of food, building materials, clothing, etc. These poor pavements have made a big increase in the cost of living, which could have been saved to a large degree.

With the lower price of labor and the more reasonable prices of materials this season, the ambitious programs of a year ago should be started now to cut down this heavy haulage cost on supplies.

When the pavements of a city or town are in bad repair it soon becomes known and trucking and pleasure traffic will pass around that locality whenever possible. This causes a loss to the business houses and hotels of that place. These losses are impossible to figure, but they are real losses to such towns and should be thought of when considering the matter of replacing bad pavements.

All these matters should be given proper weight when considering the question of issuing bonds. In many cases it will pay a municipality to pay a higher rate of interest and do the work now rather than wait for a lower interest rate.

In general it does not require the engineer to show the highway traveler where the state roads end and the city or town pavements begin. The city pavements should be kept in as good surface as the state highways—this would not only add to the pleasure and comfort of the highway traveler, but would prove a good business proposition to the municipality.

Refuse Collection in Syracuse

The department of public works of the city of Syracuse has instituted a new plan for the collection of refuse and ashes in the downtown districts, which has been the subject of favorable comment. Under the old scheme the wagons and trailers collected throughout the week, and the result was ashes and refuse on some curb every day. Commissioner George C. Scheerer, when appointed, devised the plan of mobilizing his entire force of men, wagons, trucks and trailers in the downtown section on one morning of each week, thus eliminating collections throughout the week. The plan has been successful, the entire job is finished in two hours, and the department starts work on the residence districts. The business section is clean, and outside of some inconvenience to janitors, which was quickly adjusted, everyone has approved the plan heartily.

Repairing Northern Ave. Bridge, Boston

Bottom chord eye bars removed and new ones added without the use of falsework.

Northern Avenue highway bridge, Boston, has a through pin-connected truss span about 143 feet long and 60 feet wide, carrying three roadways and two cantilever sidewalks. The trusses, 26 feet 3 inches high and 22 feet apart on centers, have 21-foot 2¾-inch panels with bottom chords made of 6 and 7-inch eye-bars having pins from 4½ to 7½ inches in diameter. The floor panels are X-braced with diagonal angles.

The bridge was seriously injured by collision with a scow that broke from its moorings and drifted under it during a heavy storm. The bottoms of many of the vertical posts were badly bent, several of the bottom chord bars were more or less distorted as well as some of the lateral braces and the chord struts. Most of the damage was sustained by the northerly truss where the end struts were bent up 4 inches and the chord bars were bent in three panels. The jaws of the vertical posts engaging the bottom chord pins were badly bent. In the next truss the bottom chord bars in one panel were bent ¾ inch and 2¼inch, four of the lateral struts and their gusset plates were badly bent, and the fascia girders in three panels were somewhat injured.

The bridge remained in restricted service and the injuries were repaired without building falsework or providing any other support for the bridge, although the operation involved the removal of some of the eye bars in the bottom chords and the reinforcement of those members with new bars, which was accomplished without removing the pins that connected them to the vertical and diagonal members and maintained the integrity of the trusses. In one panel two new 7 x 1⅝-inch eyebars were added and in another span a single 6 x 1 3/16-inch bar was added, while in several panels the bottom chords were reinforced by the addition of screw ended square rods that were coupled together forming links connecting the lower chord pins.

The lower chord pins fortunately had space between the jaws of the vertical posts to receive the links without interfering with the other members connected there. Outside of the jaws of the vertical posts the original eye bars were packed so closely that they occupied the full length of the pin up to the shoulders, where the ends were turned down to receive the nut, and in this case special new nuts were provided which virtually lengthened the pin enough to receive the new bars 1⅝ inches thick.

Each link was made with a pair of 1¾-inch square U-bars about 3 feet long with upset screw ends passing through a 6 x 3-inch horizontal yoke bar 14 inches long that was bored in the center to receive the screw ends of a straight bar that connected with the yoke engaging the pin at the opposite end of the panel. With this arrangement it was easy to engage each pin separately with its U-bar, assemble the yokes on the ends of the U-bars and finally connect them with the straight bar and make the adjustment by setting up any or all of the nuts at both ends of all the bars.

The new nuts for the 7⅝-inch pins where eyebars had to be added to the ends were made with L-shape cross-section formed by turning down the inner face of the nut and providing on it a shoulder with the diameter exactly the same as that of the finished pin and a length equal to the thickness of the new eyebar. The new eyebar was carefully assembled in position and supported while the nut was inserted in it and screwed on the pin, thus affording solid bearing for the bar nearly to the extremity of the pin.

In order to get some initial stress in the new eyebars, the distance center to center of the chord pins was measured several times very accurately. The bars were ordered approximately 3/32 of an inch shorter than the average of these measurements.

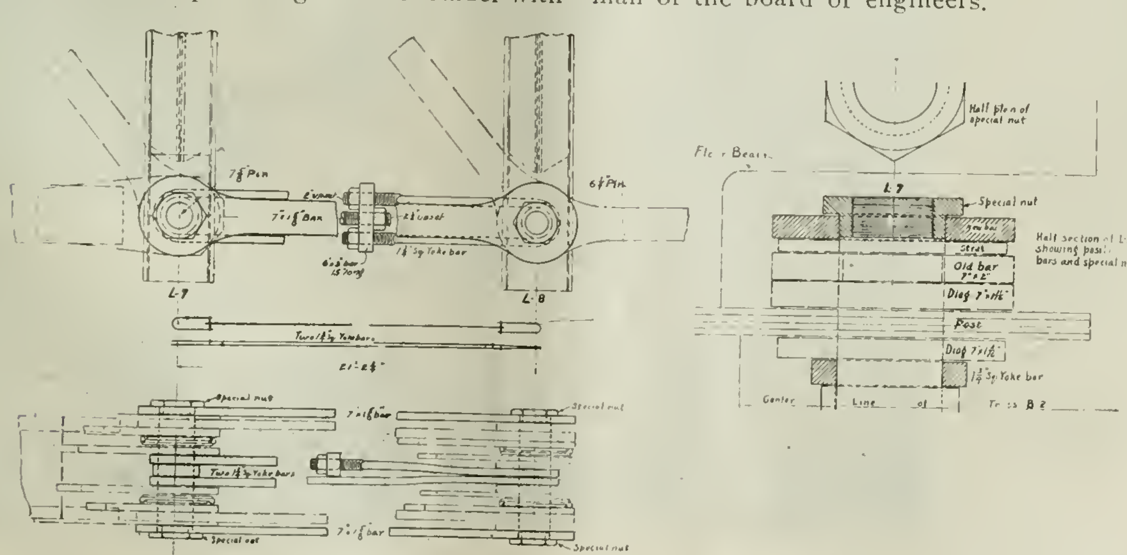
When it came to the erection of these bars it was found that a very little warming enabled the workmen to force them onto the pins and when cool the result was quite satisfactory.

The work was done by the Bridge & Ferry Division of the Public Works Department of the city of Boston, Randall D. Gardner, assistant engineer. It required a force of about ten men for twenty days and cost, including material, $5,745. The bridge was kept in service during the operation and the ingenious method devised avoided the expense, delay and obstruction that would otherwise have been necessary for supporting the bridge on falsework for disconnecting and rebuilding the trusses.

The Detroit-Windsor Bridge

According to the progress report just published in "Canadian Engineer," the designs for this great suspension bridge have progressed far enough to show that it will require for its construction about 107,000 tons of steel, including 50,000 miles of cable wire of high ultimate strength, 8,000,000 rivets and 20,000 tons of cement.

The towers will be 350 feet high and the bridge will carry 40 miles of track rails. The weight and capacity will be several times as great as those of the three great suspension bridges across the East river, New York. Charles Evan Fowler, New York, is the consulting engineer and chairman of the board of engineers.



METHOD OF ATTACHING NEW MEMBERS TO LOWER CHORDS OF INJURED CITY STREET BRIDGE IN SERVICE

A Reinforced Concrete Pipe and Trestle

The construction of a pipe line and its support entirely of reinforced concrete has recently been accomplished by Bent Bros., Los Angeles, contractors, thus enabling the concreting to be done advantageously at a central plant and permitting the structure to be assembled and erected like a steel or wooden structure, thus classifying the work, facilitating the handling of materials and finished members, and eliminating the necessity of carrying wet concrete, moving the mixing plant or building forms in place where their construction and removal would have been much more difficult and expensive than in the work yard.

The 42-inch pipe was of reinforced concrete with hub and spigot joints made in the thickness of the pipe. Where the pipe line crossed a ravine, instead of carrying it down and up again and forming an inverted siphon that would require to be provided with blow-offs, would be subjected to a considerable increase of pressure above that in the adjacent sections, and might be subject to the accumulation of sediment deposited at the low point, the pipe was carried across at grade on the bents of a reinforced concrete trestle, corresponding substantially to a framed timber trestle.

The bents of this trestle were pre-cast in single stories, each consisting of two comparatively wide, thin, batter posts and top and bottom horizontal cross pieces, making a slightly trapezoidal frame with integral solid web knee braces at each corner. These sections or stories were provided with bearing surfaces at the extremities of the batter posts and clearances between them and were easily assembled and the joints made in the field in very much the same way as wood or timber would have been handled, and providing for rapid construction that, as soon as completed, was ready to carry the large pipe; and the latter, soon after jointing and testing was ready for service, thus considerably reducing the time otherwise necessary for the concrete, cast in forms at the site, to harden and acquire sufficient strength.

ERECTING TRESTLE BENT, STORY BY STORY

St. Paul's Municipal Power Plant

The city of St. Paul has applied to the Federal Water Power Commission for a permit to erect and operate a power plant at High Dam on the Mississippi river. It is estimated that the plant would cost $700,000 and develop 10,000 horsepower. The money would be raised by a bond issue ratified by the electorate.

Washington's Water Front a Disgrace

The District of Columbia wharf committee has reported that "the condition of the water front along the Washington channel is admittedly a disgrace to the National Capital." Except for four wharves, "practically all of the existing bulkhead walls, wharves and buildings used for commercial purposes were built in a haphazard manner by private individuals or corporations with no regard whatever to uniformity." The committee cautions the commissioners that "in any contemplated scheme of improvement of the water front, adequate frontage should be reserved for steamboat passenger and freight traffic."

Let Autumn Contracts for 1922 Road Work

Secretary Hoover has written the governors of the various states asking them to let contracts for next year's work in the autumn instead of postponing them until spring. In this way thousands of men might be sure of employment during the winter; in addition to which the work could be started earlier, much of the material hauled during the winter, and other advantage secured.

ASSEMBLING PRECAST PIPE SECTIONS ON REINFORCED CONCRETE TRESTLE

PUBLIC WORKS.
Published Weekly
by
Public Works Journal Corporation
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba..$3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

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A Promising Development

The formation, by prominent labor union officials, of a new labor organization pledged to correct the most unjust and dangerous features of labor unions, as noted on page 118, is one of the most encouraging signs that could possibly appear at the present time on the industrial and constructional horizon.

The principles involved are broad and definite, and will receive the approval and support of thinking men and women. These principles, briefly stated, are: The open shop; the rights of the public; compulsory arbitration; and, consequentially, the elimination or very great reduction of strikes. If to these sound principles be added one more that we have always maintained is of great importance, namely, the incorporation of all labor organizations and their legal responsibility for all their acts; and another, that production should be increased and improved, never restricted; industrial relations founded on them will become beneficial and satisfactory to all concerned, mutual appreciation and co-operation between labor and capital will be attained, and great progress and prosperity will result.

The fact that the new movement is sponsored almost entirely by labor union officials is strong presumptive evidence that the honest and intelligent labor element is at last determined to repudiate and actively resist the propaganda and actual crimes of walking delegates, radical elements, bolshevists and I. W. W. affiliations who, especially of late, have, in many cases, overwhelmed the conservatives and carried out policies disgracing the unions and working immense damage to the whole country. The public, formerly sympathizing with labor, has at last recognized the dangerous abuses and a strong feeling antagonistic to militant unions has increased to a point that makes action of this sort the best possible thing for the unions themselves.

The Development of a Rational State Highway Policy

The state of Connecticut, with an assessed valuation of nearly $2,000,000,000, has 12,000 miles of highways connecting its 168 towns, many of which are active manufacturing centers, including important trunk lines, such as the New York Post road and others. There are about 450 miles of stone and bituminous macadam, 175 miles of concrete of all sorts and about 1,000 miles of gravel, stone and earth or their combination, leaving a balance of 10,400 miles unimproved.

During the first years of its existence, the State Highway Department provided improved hard-surface roads at a cost of a few thousand dollars per mile, that answered all the then present and anticipated requirements, but with the advent of automotive vehicles existing roads on the trunk lines were found entirely inadequate and were rapidly destroyed and new roads were demanded, costing approximately ten times as much as the old roads for their construction.

There was immediately presented the new problem of raising and properly expending many millions of dollars for construction, reconstruction and maintenance of roads that, although they quickly created a vast actual and potential increase in wealth, required in advance unprecedented expenditures that could not be borne by or justly assessed on either the local residents or on the state as a whole. It was therefore determined to place as large a proportion as possible of the cost on the automotive vehicles which necessitated and were principally benefited by the outlay.

A careful analysis of official data combined with a survey of the actual benefits and profits derived by the vehicles and consideration of the benefit to the general public finally resulted in the imposition of a yearly tax of $187.50 for a 5-ton truck, which, although only about 1/3 as much as was considered automatically justified will, when added to the other resources of the highway department, provide for an increased amount of construction and maintenance that, in 1921, will amount to approximately $7,000,000, and that allowing for a probable decrease in automotive vehicles in the near future will allow an average budget of about $6,000,000 for the next two years.

No hard and fast rule has been adopted for the type of roads to be reconstructed, but it is anticipated that about one-third of them will be concrete and that less expensive types will be used where they will be equally satisfactory under less exacting traffic conditions.

The construction and maintenance policies are co-ordinated with a control system that regulates the traffic so as to divert, suspend or limit it on certain roads when it would be injurious and to provide for heavy traffic under restrictions, thus maintaining proper routes at all times and saving roads from serious injury under adverse conditions.

Labor Wages Approaching Normal

A special report to Public Works from the Water Works Department of the city of Waynesboro, Ga., states that at the present time the rate paid there for common labor is $1.10 per 10-hour day. In 1914 it was $.83 for a day of the same length. When a similar ratio is widely enough established in other parts of the country there will be no delay or doubt of enormous increase in construction.

Boston High Pressure Water System

For several years the installation, now nearing completion, has been going on for the separate high pressure water supply system to protect the business part of the city of Boston from fire danger. The first mechanical installation of the equipment to operate the pressure system has been installed in the Boston Elevated Railway Power Station at Commercial street where space has been secured and provisions made for general supervision of the plant that will afford the necessary shelter and attention at a very small additional expense. There are here two steam turbine-driven 3-stage centrifugal Worthington pumps, with a capacity of 3,000 gallons per minute at 300 pounds pressure and 4,550 gallons at 200 pounds pressure. They are supplied from two 16-inch suction mains, one connected with the Boston low-service system and one with the high-service system and from a third 16-inch main delivering salt water. They are all cross connected to two 16-inch discharge mains insuring a high pressure supply from either one of three sources for either of the two outlets by means of either of the pumps, thus providing against almost any possible combination of accidents.

The No. 2 installation at the Edison Illuminating Station, on Atlantic avenue, opposite Pearl street, has two motor-driven 4-stage centrifugal pumps, each with a capacity of 3,000 gallons at 300 pounds pressure and 4,550 gallons at 200 pounds pressure, or 7,000 gallons per minute at 175 pounds pressure. They are similarly supplied from separate low-pressure, high-pressure and salt water mains and discharge through two separate 16-inch mains. The station has a very large storage battery capacity and, like Station No. 1, has sufficient vacant room in reserve to permit the future installation of a third pump if necessary.

Station No. 3 at the Edison Illuminating Company's Station on Stewart avenue for two electric units similar to those at No. 1 and No. 2 will have the same equipment installed as the previous ones, with the exception of the salt water supply, which will be omitted there.

The two discharge mains from each station are for alternate operations as a duplex distribution system and are provided with extra heavy pipes, in which the unbalanced pressure is cared for by joints made with 95 per cent lead and 5 per cent tin, developing sufficient strength so that no ties are required.

The alloy metal, which is used only on unbalanced joints, is 3½ inches deep and is compacted with dog sets, one man holding the caulking tool and the other man using a 4-pound hammer, finishing with a lighter hammer. These joints were developed to avoid the risk that was occasioned by the gradual rusting away of the wrought iron tie rods, which were found in some cases to totally disappear in eight years. On straight work the regular lead joints are used.

Every pipe was subjected for one hour to a test of 400 pounds pressure before the joints were covered, and the leakage in the last 20 minutes of the test was measured and was found to be less than the permissible amount of 2 gallons per linear foot of pipe joint for 24 hours.

The high-pressure system contains approximately 12 miles of 16 and 20-inch mains and it has about 300 hydrants in the district having the highest fire hazard.

Board of Appeals in Zoning*

General conclusions applicable to all states and cities. Appointment and powers of New York Board of Appeals.

The main difficulty in establishing a zoning plan is to make it effective and at the same time avoid arbitrariness. Human wisdom cannot foresee the exceptional cases that can arise in the administration of a zoning ordinance. The strict word of the law may sometimes be the height of injustice. No zoning ordinance standing by itself can provide for the proper adaptation of the spirit of the law to each exceptional case. On this account, in the administration of building laws in general and especially zoning ordinances, it has been found desirable, even necessary, to create an expert board, usually called a board of appeals, to adapt the application of the law to particular exceptions so as to carry out the spirit of the law instead of allowing it to be arbitrary or confiscatory. A city cannot create such a board without authority from the state legislature to do so. Therefore any state enabling act to authorize cities to adopt zoning ordinances should contain a provision empowering the city to appoint such a board and outlining its functions. Merely to say that a city can appoint such a board to do what is just and lawful is not enough, and probably such a statement in the law gives the board no power whatever. The state enabling act must either prescribe the rules that it must follow or better yet empower the city council to assign to it in the ordinance certain specified classes of exceptional cases for it to decide. The council should also prescribe a rule for it to follow in deciding each class of cases. Such a board should be given three distinct fields, first, to rectify errors in granting or refusing permits, secondly, to pass on exceptional cases where specified in the ordinance itself, and third, to vary the literal requirements of the law where unnecessary and excessive hardship is caused and the intention of the law is equally accomplished by an alternative method to be prescribed.

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*Excerpts from a paper by Edward M. Bassett, counsel of zoning committee, New York City.

The state enabling act should provide for the review of the decisions of a board of appeals by the court. This court review, however, should not be a substitution of the judgment of the court for the judgment of the board of appeals. The findings of an expert board should not be interfered with by the court unless the board has exceeded its lawful powers or misinterpreted the law or abused its discretion. In states where under such circumstances the courts will not assume this position, the enabling act should require it.

A board of appeals may well be composed in part of officials whose duties bring them in touch with buildings and their use throughout the city, and in part of non-officials expert in such fields as design, construction, fire protection or sanitation. As a rule the official who issues permits in the first instance should not be a member of the board of appeals because it is better that he should not be compelled to act on his own prior decisions. Neither should a member of the city council be on the board because of the difficulty of his acting as a legislator in one position and as an administrator in the other.

States and cities will not go far afield when they come to define the functions of the council and the board of appeals if they will remember that the council is the city legislature and as such has entire control over the zoning ordinance and maps. The board of appeals should have no control over the ordinance and maps, but should pass on specific permits arising under the provisions of the ordinance and maps. The council then has its own field and the board of appeals its own separate field, and these do not overlap. The council does not adjudicate on a particular building or the use of a particular building. The board of appeals passes on nothing but particular buildings. The council impresses a certain quality on the land itself. The board of appeals in certain exceptional cases varies the application of the ordinance for a building or use which temporarily occupies the land.

Wherever the application of a zoning ordinance is arbitrary the courts are likely to declare it void in that particular. After an ordinance has been declared void in five or six particulars it has little binding force. Just here is where the need of a board of appeals comes in.

No words of a written law can prescribe what ought to be done in thousands of exceptions which can arise in the construction and use of buildings. The council of a large city cannot and ought not to give its time to granting specific permits for buildings.

The ordinance and maps should be comprehensive and when altered the alterations should apply comprehensively and not be limited to a single building or plot. Some board that can investigate the environment, view the plot or building if necessary and express an expert opinion on the situation, should in proper cases under the guidance of the rules laid down by the council be given power to vary the strict letter of the law. . . .

The city of New York at last obtained the board of appeals as an adjunct to its zoning plan. The board has risen to a position of dignity and importance. Fully three-fourths of its cases arise under the zoning resolution. It publishes a weekly bulletin giving its calendar and decisions. The questions that it passes upon equal in magnitude and importance the cases that come before the trial courts. Its chairman and staff give all of their time to its work, make inspections and transact an amount of detail work regarding buildings and uses that it would be quite impossible for a city council to cover. Its members are presumed to be experts in buildings and their uses. They are quite uniformly supported by the courts.

. . . The board consists of the fire commissioner, the superintendents of buildings, the chief of the uniformed force of the fire department and six other members appointed by the mayor.

"At all times there shall be among the appointed members of the board persons qualified as follows: One, other than the chairman, shall have had not less than ten years' experience as an architect; one, other than the chairman, shall have had not less than ten years' experience as a structural engineer; one, other than the chairman, shall have had not less than ten years' practical experience as a builder. The mayor shall designate one of the appointed members of the board as chairman and shall also appoint a secretary."

. . . The charter and zoning resolution did not make the board of appeals a court to exercise its discretion over the entire field of zoning. It has the following powers regarding zoning and no more:

(a) To rectify on appeals the errors of building superintendents and other administrative officials in passing on applications for permits;

(b) To decide border-line and exceptional cases where specified in the ordinance;

(c) To vary the literal requirements of the law in individual cases where unnecessary and excessive hardship is caused and the intention of the law is equally accomplished by an alternative method to be prescribed by the board of appeals.

Lights and Shadows of the Activated Sludge Process[†]

By Harrison P. Eddy[*]

Developments up to date; description of process, theory of its operation, extent of purification accomplished, effect of temperature, re-aeration and other details.

It is the object of this paper to touch briefly upon a few of the most interesting features of the activated sludge process and to point out the facts which have been rather thoroughly demonstrated and of which we are comparatively certain, and to indicate those which are still in doubt and upon which more investigational work and experience are required to determine the natural laws which govern and to perfect methods of procedure. In venturing to classify certain conditions as established facts, it is recognized that the process as a whole is still in the experimental state, that there are many conditions under which it has not been tested, and that circumstances may exist under which those features which we now feel are clearly understood will present unexpected difficulties and uncertainties.

DESCRIPTION OF ACTIVATED SLUDGE PROCESS

For the benefit of those who have not given particular study to this process, it may be well to state briefly, in a general way, what it is and what it is capable of accomplishing.

When sewage containing a suitable supply of dissolved oxygen is agitated for a sufficient length of time, the fine suspended matter and the colloidal substances here gather into small aggregations called flocculi or floc.[‡] When the sewage thus coagulated is permitted to stand quiescent, this floc quickly settles and forms at the bottom of the basin a very thin mud or sludge. The sludge is then withdrawn, and normally contains about 98 per cent water. If such sludge be introduced into sewage, the rapidity with which the suspended and colloidal matters are coagulated may be greatly increased.

Thus the process as ordinarily carried out consists of adding sludge to the sewage, in proper proportion—roughly 1 to 5—introducing sufficient air to provide enough dissolved oxygen to maintain aerobic conditions, and agitating the mixture until practically all of the fine suspended and colloidal matter has been flocculated or absorbed by the floc introduced into the sewage. The mixture is then conducted to settling basins where the floc is removed by sedimentation and the clear supernatent water passes away as effluent. That portion of the sludge which is not required for the treatment of incoming sewage is diverted to sludge lagoons or it may be conveyed to a dewatering and drying plant where it can be converted into material suitable for use as a fertilizer base.

By this treatment sewage and many industrial wastes can generally be clarified and purified to a marked extent.

THEORY OF PURIFICATION

The first and perhaps most noticeable function of this process is that of coagulating or flocculating the suspended and colloidal matters in the sewage. This action is similar in effect to the well-known chemical coagulation with sulphate of alumina or sulphate of iron and lime, and the floc resembles the chemical coagulum, particularly the ferric hydrate from the sulphate of iron and lime treatment.

The floc is a sponge-like mass or an open-mesh network which in the process of formation may envelop, entrap or entrain colloidal matter and bacteria. The sponge-like structure of the floc offers a very large surface area for contact, and this floc appears to be able to absorb colloidal matter, gases and coloring compounds. When the floc is driven about in the liquid it has a sweeping action by which the colloidal substances may be said to be swept out of the water, or as stated by Philip Morley Parker, the "process may be regarded as passing a filter through the water in place of passing the water through a filter." Thus far the process appears to be primarily of a physical nature. It has been demonstrated, however, that it cannot be carried out under sterile conditions.

Just what the action of bacteria and other organisms may be, is a subject which should receive further investigation. One plausible theory is that the bacteria which are contained in the cell-like structure of the floc, feed upon the very finely divided matter and thus relieve the floc of its burden of such substances and restore its faculty of absorption to such an extent that when introduced into the incoming sewage the floc efficiently performs its function of absorbing the colloidal matter which will again be consumed by the living organisms which thus cause its regeneration. Because of these properties the sludge has come to be called "activated sludge," a term suggested by Ardern & Lockett.

One of the cardinal principles of this method of treatment is that there must be dissolved in the sewage an ample supply of oxygen to maintain aerobic conditions. The action of the organisms in consuming the colloidal matter is one of digestion or oxidation—sometimes referred to as "moist combustion." Through this action the actual weight of suspended and colloidal matter is reduced, the products of the combustion being carried off in the form of dissolved or gaseous matter. This process, under favorable conditions, may extend to nitrification, by which substantial quantities of nitrates and nitrites are formed. Nitrification, however, is not necessary to the maintenance of sludge activity, as seems to have been the opinion at the outset.

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[*] Of Metcalf & Eddy, consulting engineers, Boston, Mass.

[†] Paper before the Western Society of Engineers.

[‡] The word "floc" as used herein, signifies a single sponge-like mass or an aggregation of such masses.

EXTENT OF PURIFICATION ACCOMPLISHED

One of the bright spots in the experience with activated sludge is its high efficiency as a process of sewage purification. This much at least may be said to be well established. At Houston, Texas, it is stated by City Engineer McVea, that "fish have lived in the outlet chamber (effluent) for more than a year."

So large a portion of the suspended solids and colloids may be removed that under ordinary conditions the effluent will be clear and contain but very little suspended matter; from 5 to 20 p. p. m., as a rule.

The sweeping process by which the colloids are absorbed, or coagulated, is also effective in reducing bacteria—not by destroying them but by physically removing them.

In many cases color may also be removed, probably by action similar to that of mordants.

In the case of odors, some may be oxidized directly and some absorbed, the resulting effluent being comparatively free from odors noticeable to the ordinary observer.

Oxidation of organic matter in solution occurs coincidentally with the flocculation, and there may be nitrification where the treatment is fairly complete. In the latter case the treated sewage may be charged with a substantial quantity of available oxygen in the form of nitrates and nitrites, which will serve as a factor of safety against future putrefaction.

An interesting characteristic of this process is its adaptability to partial treatment. If the removal of colloids and bacteria and the production of a moderate degree of stability be sufficient, the process can be stopped short of material oxidation of organic matter and nitrification. On the other hand, if complete stability and oxidation of a substantial portion of the dissolved organic matter are required, the process can be so operated as to accomplish this, at least in many cases. As early as 1917, T. Chalkley Hatton, chief engineer of the Milwaukee Sewerage Commission, determined upon the following standard as a measure and limit of purification to be effected by the activated sludge process at Milwaukee:

Reduction of bacteria	90 per cent
Reduction of suspended solids	95 per cent
Stability by Methylene blue	72 hours

Prolonged tests with the strong sewage containing a substantial proportion of industrial wastes have demonstrated that it is entirely practicable to meet this standard at Milwaukee.

While it may be proper at the present stage of development to assume that in general purification may be carried to almost any extent desired, it is important to consider carefully the character of the sewage or wastes to be treated for there may be disturbing influences similar to those which appear to have been important at Worcester. There—probably because of the acid iron wastes from the wire mills—the extent of purification was decidedly limited, notwithstanding the use of very large quantities of air, a goodly period of aeration and re-aeration of the sludge.

The late Matthew Gault concluded that Wormester sewage is apparently of such a character that nitrification does not take place readily and that it would be practically impossible to operate so as to constantly obtain uniformly good results. It may be noted, also, that nitrification does not readily take place when this sewage is treated by intermittent filtration.

AERATION

The aeration feature which has been more generally studied than any other portion of the process, as at Milwaukee, Cleveland, Worcester, and Packingtown, and Stockyards in Chicago, and elsewhere, apparently is comparatively well understood.

Air is utilized for two purposes—for maintaining aerobic biological conditions and for agitation. Agitation, however, may be accomplished by other means, such as purely mechanical devices.

The oxygen requirements for the support of aerobic conditions are relatively small. Crawford and Bartow found that only about 5 per cent of the oxygen of the air used for aeration, appeared to be utilized, basing their conclusions upon analyses of the air entering and the gases escaping the aeration tank. The writer found only 10 per cent of the oxygen disappearing in the case of strong tannery wastes. If the oxygen supply is to be obtained from air blown into the sewage, there must be sufficient opportunity for the sewage to dissolve out the oxygen while the air is passing through it.

The quantity of air required for agitation is very large. It is necessary to provide sufficient agitation to prevent the heavy suspended solids from settling down on to air diffuser plates and thus clogging them. Removal of suspended matter by fine screening is a substantial aid in preventing such trouble. Even sewage which has passed a fine screen having openings ⅛-inch by 2-inch, may contain sufficient solids of this character to cause clogging of plates if the air supply be permitted to fall much below 1 cubic foot per minute per square foot of plate area. By finer screening it might be possible to reduce this quantity slightly. Whatever be the character of the sewage, the volume of air used must be sufficient to prevent any accumulation of solids upon the diffuser plates.

The volume of air required for aeration is mainly dependent upon the following general conditions:

Composition of sewage to be treated.
Quality of effluent desired.
Period of aeration.

Proportion of sludge to be returned to the sewage.

Temperature of aeration.

COMPOSITION OF THE SEWAGE

The composition of the sewage has a very material effect upon the volume of air required to maintain aerobic conditions and to provide suitable aeration. A strong sewage, or industrial waste, requires more air than a weak one, not because of the direct action of the oxygen on the organic matter, but because there is a greater quantity of colloidal matter to be absorbed by the coagulum and in some cases also because of the larger quantity of dissolved organic matter to be oxidized. The larger the quantity of colloidal matter the greater must be the effective absorbing surface. This may be afforded by increasing the proportion of floc in the liquid or by increasing the period during which the flocculation is continued. If the volume of return sludge be increased, bacterial digestion will be greater and consequently the quantity of dissolved oxygen must be larger in order to maintain aerobic conditions. Furthermore, the digestion of the absorbed colloidal matter and the reactivation of the sludge will require more intense and more prolonged bacterial action in the case of the stronger liquid, thus requiring a greater supply of oxygen for biological purposes.

It may therefore be necessary, with the stronger sewage, to prolong the period of aeration. Such a course naturally increases the quantity of air required for oxidation.

For these reasons and many others, it is important to consider the composition of the sewage to be treated. In addition to the strength of sewage, it is necessary to consider the effect of particular characteristics, such as turbidity, the nature of the organic matter—whether relatively stable or easily decomposed—and the effect of chemicals from industrial wastes, such as acids and alkalis. A relatively fresh sewage may be low in turbidity, and therefore comparatively easily coagulated and oxidized. On the other hand, certain industrial wastes such as those from stockyards and tanneries, may contain such large quantities of colloidal matter as to require prolonged treatment for their removal. Some industrial wastes such as the pickling liquors from the wire mills at Worcester, Mass., tend to inhibit bacterial action and thus increase the required period of aeration or volume of air, or both. It is necessary also, as found by Mr. Fuller, that a sufficient quantity of floc-forming material be present in the wastes. Otherwise such matter must be added in order to secure the desired result.

THE QUALITY OF EFFLUENT

The quality of effluent to be produced has an important bearing upon the quantity of air required. In the case of domestic sewage and some industrial wastes it is possible to secure clarification with a lower expenditure of air than would be required to produce a stable effluent. On the other hand, with some industrial wastes high in turbidity, it may be impossible to secure clarification without at the same time producing a practically stable effluent. The extent of oxidation will, however, increase with increasing volume of air used. It has also been demonstrated that the aeration process must be carried far enough to secure reasonably good clarification in order to produce a sludge of such character and density as to permit satisfactory sedimentation, handling and dewatering. Otherwise the operation of the plant will be difficult, if not impracticable. Within the limitations suggested, it is feasible to limit the degree of purification and consequently the quantity of air required, in accordance with the quality of the effluent to be produced.

PERIOD OF AERATION

The period of aeration has been found to be a very important factor in the quantity of air required. Within limits, the volume of air will decrease with increasing period of aeration. Comparative tests have indicated that with a period of 8 hours only about one-half as much air is required as with a period of 4 hours. With the longer period of aeration, however, the rate of air supplied must be sufficient to maintain proper agitation and prevent the deposition of solids upon the air diffusers, as already pointed out. Where the sewage or wastes contain an abnormally large quantity of colloids, it may be absolutely necessary to provide a long period, such as 8, 12, or even 20 hours aeration in order to remove the colloids and produce an effluent having a moderately high stability. If an unnecessarily large proportion of sludge be returned, or if the period of aeration be unnecessarily prolonged, excessive quantities of air will have to be provided.

TEMPERATURE

Temperature has an important influence upon aeration. Very high or very low temperature of the sewage is detrimental. The unfavorable effect of low temperature has been repeatedly demonstrated. This effect may be in a measure, although probably not entirely, offset by increasing the volume of air. Fortunately in many cases the stream requirements are less exacting during cold weather than at other seasons of the year, and consequently it may be permissible in some cases to discharge a somewhat inferior effluent during the winter, and thus avoid the necessity of increasing the air supply.

For ready estimation of the quantity of air which will be required for biological action and for agitation, more data are needed than are now available. While the strength of sewage has a very important bearing, a comparison of the results of analyses with the quantity of air used at the several activated sludge plants, with a view to demonstrating this relation, is very disappointing. This is because of differences in methods of chemical analysis, lack of important determinations in some cases, differences in methods of operation, and many other dissimilar details. There are so many of these unharmonious features that it is only by a detailed study of each case, and a comparison of the conditions with those of the project under consideration, and the exercise of judgment, that it is possible to arrive at a safe estimate.

As a general statement, where the aeration is carried out in continuous-flow tanks of 10 to 15 feet depth, with area of diffuser plates in proportion of 1 to 6 of tank area and a period of aeration of about 6 hours, the quantity of air may be about as follows:

For rather weak domestic sewage	1.0 cu. ft. per gal.
For strong municipal sewage containing some industrial wastes not particularly detrimental to bacterial life	1.5 cu. ft. per gal.
For weak municipal sewage containing considerable industrial wastes some of which are detrimental to bacterial life, as for example acid-iron wastes	2.0 cu. ft. per gal.
For strong municipal sewage containing considerable industrial wastes some of which are detrimental to bacterial life, as for example, acid-iron wastes	4.0 cu. ft. per gal.
For municipal sewage containing sufficient industrial wastes not specifically inhibitive of bacterial life, to decidedly influence the composition of the sewage. e. g. packinghouse, tannery, etc.	3.0 cu. ft. per gal.
Strong packinghouse wastes	4.0 cu. ft. per gal.
Strong tannery wastes containing a very large proportion of colloids but settled before aeration	6.0 cu. ft. per gal.

RE-AERATION OF SLUDGE

The evidence is conflicting as to whether there be advantage to be gained from sludge re-aeration. If the sludge is dense, i. e., contains 2 per cent to 3 per cent solids, the air appears to accumulate in large bubbles and escape from the surface at irregular intervals. This tendency seems to render the air less effective as a means of agitation and possibly interferes to some extent with the uniform distribution of the dissolved oxygen throughout the sludge. A test at Milwaukee indicated that there was not sufficient advantage to warrant the adoption of this feature.

On the other hand, Pearse found that in the treatment of Packingtown sewage the return of re-aerated sludge showed "somewhat smaller requirements in the amounts of air needed, and a reduced volume of sludge to be returned."

If the rate of air supply be uniform throughout the 24 hours the lower flow of weaker sewage at night will permit the sludge to become more thoroughly activated than during the day-time and in effect accomplish the end sought in the re-aeration of the sludge by treatment in separate tanks. Similarly on Saturday afternoons, Sundays and holidays the sludge may be revived by appropriate treatment. This result is obtained in practice and has been very noticeable and beneficial in some cases.

PECULIARITIES OF FLOC

The little sponge-like aggregations of fine suspended and colloidal matters have no regularity of structure but as merely masses of independent particles held together by slight forces of attraction. They are of great size in relation to the weight of the solids composing them. The forces by which the particles are held together are so slight that the sludge must not be very vigorously agitated or the floc will be broken up. This is readily demonstrated by shaking a portion of the flocculated liquid in a bottle, when the floc will be seen to revert to the colloidal condition. Hence it is necessary to avoid intense agitation in aeration tanks and to induce as little violent agitation as practicable when pumping and otherwise handling the sludge or the sewage after the sludge has been introduced into it.

The character of the floc varies greatly under different conditions. That produced by thoroughly aerating sewage for such a period of time and under sufficiently favorable conditions as to produce a highly purified effluent will usually be of a golden-brown color, relatively compact and heavy, and will settle with surprising rapidity. On the other hand under-aeration will produce a light, voluminous floc which will not settle as rapidly and which will form a very voluminous sludge of high water content and correspondingly difficult to handle. Under-aeration may be due to furnishing too little air or to too short a period of aeration due to crowding too great a volume of sewage through tanks provided with the proper air supply and period of aeration for a small quantity of sewage. The effect of low temperature is similar to that of under-aeration and in northern climates there is usually greater difficulty in producing a good sludge in winter than during other seasons. Such a condition may be caused temporarily by the introduction into the sewers of cold water from melting snow. An activated sludge plant should be designed with an adequate factor of safety to meet such conditions.

It is just as important to avoid over-aeration, for this results in a re-solution of the floc into colloidal matter with a consequent poor effluent.

The condition of the floc is very dependent upon the sedimentation process. If the sludge is allowed to remain too long without air it loses its activity and becomes septic. It is therefore important to provide for the removal of the sludge from the sedimentation tanks as promptly as is consistent with the proper concentration—in fact, the extent of concentration is limited by the need of maintaining the sludge in good condition.

DURABILITY OF DIFFUSER PLATES

It will be remembered that during the early tests porous plates used as air diffusers became more or less disintegrated within a relatively short period of time. In other cases such plates became so seriously clogged that the pressure necessary to force the required quantity of air through them became prohibitively great. This was due in part to impurities in the air and in part to rust or other material from the plate holders, which gradually sealed the pores of the plates. At Houston, Mr. Fugate has found that porous plates clogged with rust can be cleaned by immersing them in hydrochloric acid at 98 degrees Centigrade.

Improvements in the manufacture of plates appear to have overcome danger of disintegration, and experience during the past three years has demonstrated that it is practicable to so purify the air and construct the plate holders as to avoid danger of clogging within a short time. The period covered by this experience, however, is too short to show how long a life such plates will have. However, in view of the fact that after continuous use for a period of about two years there is no marked increase in the pressure required to drive the air through the plates, the assumption seems to be justified that the plates will have a useful life of a number of years, certainly as many as five years and possibly a very much longer time.

(To Be Continued)

Construction Questions Answered

How to Handle and Erect Girder Spans Without Special Equipment III*

With fixed and moveable derricks.

Up to about 30-feet span, highway girders can be unloaded, stored, shifted, reloaded, and erected in position by one or more ordinary builders' derricks; spans of more than 30 feet, up to the ordinary limit of highway girder construction, can be handled in the same manner by larger, stronger derricks, without the use of other plant for either long or short spans.

Derricks are universally a part of the general contractor's equipment, are to be had in almost all localities, so that they can be purchased or rented under most circumstances and if not can be easily constructed from imported or native timber rigged with wire or manila rope and standard fittings purchased from dealers, or their equivalent that can be manufactured by any capable blacksmith and machinist. This enables derricks to be constructed in very remote localities, where the delay and expense of shipment is an objection to sending them complete from the contractor's yards or the manufacturer's shop.

If a large number of spans are to be erected in one place, as, for instance, in the construction of a long girder viaduct or if only a single span is to be erected at a point distant from any other construction work involving the use of derricks, the situation should be carefully studied with a view of devising some means of handling and erecting that will involve the lowest total cost, although the expense for the single span will be much greater than for one of a number of spans erected by special methods and apparatus. In other cases it will very often be found most convenient and economical to handle and erect the girders with whatever derricks are most available.

The great advantages of derricks for girder erection are their simplicity, flexibility, ease of installation and removal, wide range of application, rapidity of action, general availability and the universal familiarity that most contractors and their employees have with their use.

TYPES AND RIGGING

Derricks may be stiff-leg or guyed, fixed or moveable, of wood or steel, and of any dimensions and capacities from a 15-foot, 2,000-pound boom of a miniature jinniwink derrick to a 100-foot boom with a 50-ton capacity. They may be made of wood or steel, may be rigged with steel or manila rope, and may be operated by hand or by steam, compressed air, electric or gasoline engines. The hoisting engines are generally of standard derrick type and of late years the steam engines are very often run by compressed air, in order to eliminate the use of coal and installation of the boiler plant and the employment of a licensed engineer. Some derrick hoists are operated by electric or gasoline motor that consumes no fuel when not in operation and are very simple in their function.

Jinniwinks are very small, light, stiff-leg derricks, permanently attached to their sills that form skids on which they are easily moved from place to place. They are quickly shifted, have independent stability and are often operated with hand windlasses or very small motor hoists. They are chiefly used for handling light loads, like single I-beams, small columns or struts and are very convenient for use in the erection and removal of large derricks. They are suitable for assembling light floors and braces after the girders are erected and can even handle small size girders.

The ordinary minimum guy or stiff-leg derricks have a boom about 25 feet long of at least 5,000 pounds capacity. Derricks with 50-foot booms of 8-ton capacity are very common and can easily be made with ordinary fittings. If the length or capacity of the boom is greatly increased it is necessary to have special design, construction and operation.

Standard fittings are likely to be safe for loads up to 10 tons; for very heavy loads, tremendous direct and eccentric stresses may be developed, necessitating very careful design, fabrication and assembling. For light loads, wooden derricks and manila lines are suitable, for very heavy ones, steel derricks with section adjustable booms and masts rigged with steel ropes, are generally used. They are not often included with the equipment of general contractors, except those who specialize in the erection of steel work and other heavy construction. They can, however, sometimes be secured by small contractors from large contractors, bridge shops, railroads and others maintaining extensive plants, but it is to be borne in mind that their transportation, erection and removal are very expensive, require the services of an expert and should not be attempted unless necessary.

The first derrick installed is usually erected by the aid of a ginpole, sheer legs, or equivalent device, with which the mast is hoisted and maintained until securely guyed in position, after which a tackle suspended from the mast can be used for erecting the boom and, in the case of a stiff-legged derrick, the stiff-legs, sills and braces. If a traveling derrick is erected it can, of course, be used for the erection of all the other derricks.

It is essential that a guy derrick shall have at least four guys, and for heavy work six or eight are preferable. Their lower ends must be secured to abundant reliable anchorage, to which they

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*Part I—Transportation to site and erecting by steam protrusion was published July 3d.

Part II—Erection by cribbing, jacking, rolling and skidding was published July 30th.

ERECTING WITH SINGLE DERRICK AND FLANGE HOOKS

may be made fast directly or, in the case of heavy work, sometimes through a convenient adjustment such as a small tackle or turnbuckle. The sills of stiff-leg derricks are usually loaded with the hoisting engine, boiler, fuel supply or any convenient counterweight to give them independent stability.

Stiff-leg derricks may be easily made moveable by seating the mast and stiff-legs on, and rigidly connecting them to, the horizontal sills forming the framework of a platform that is mounted on trucks or single wheels running on a broad-gauge track that enables the derrick to travel freely from place to place either by pushing it or by the hoisting engine operating a line anchored in advance.

Before putting into service, the mast, boom and fittings should be very carefully inspected, timbers should be bored to detect indications of decay, and the wire or manila rope be very thoroughly examined for defects. These should be oiled, the tackles carefully rove, and the hoisting engine overhauled, cleaned and tested. Whenever the derrick is left idle over night or for holidays the boom should be carefully secured against meddlers and before commencing work the guy and anchorages and hoisting 'tackle should be carefully examined to see that they have not been accidently or maliciously injured.

HOISTING CONNECTIONS

When girders are handled by derricks special attachments are necessary to connect them to the hoisting tackle. The use of chains for this purpose should never be permitted, but wire or manila rope slings properly made and adjusted may be used instead. Where there is much handling of girders to be anticipated it is desirable to have a pair of bent-plate hooks attached to the hoisting tackle. These should be of proper size and strength to be attached to the top flange of the girder and should be provided with a lock bolt to secure them in position.

If clamp hooks are not available or if special reasons require it, girders may be handled by yokes made of a pair of cross pieces and two screw bolts clamped tightly around them and provided with an eye-bolt or other device suitable to receive the hoisting tackle.

If the girder is to be handled by a single derrick, care must be taken to attach the hoisting tackle at exactly the center of gravity. If two derricks are used the tackles may be attached at opposite ends of the girder or at equal distances from the center if they are required to carry equal parts of the load, but if not, one derrick may be attached by one end to carry the lightest part of the load and the other at a distance from the other end proportionate to the excess load that it is intended to carry.

If possible, the derrick booms should be raised or lowered to the required height before lifting the girder. Care should be taken in operating the tackles when it is necessary to raise or lower the loaded boom. Two lag lines should be attached in opposite directions to each end of the girder, four in all, to enable it to be controlled while in the air and the derrick boom may be swung while loaded by lag lines attached to it or by a line from its bull wheel to the engine if it is operated by power.

Fastenings of steel rope are always made with rope clamps or clevis sockets. Manila lines are secured by standard hitches familiar to all riggers and described in many engineer handbooks. The half hitch is the commonest fastening, is very easily made and when two or three times repeated is very secure on a taut line and will hold small objects. The becket hitch is merely two half hitches made backwards, and is much used for fastening the end of a line to a pulley block. It will not undo and the free end does not require lashing. This hitch is apt to jam, so the line must be cut to release it. The jury mast hitch is used to secure guys to a derrick head. A double bowline hitch is very convenient for a seat for a man hoisted to the top of a derrick.

ERECTING 39-TON GIRDERS

The Torresdale Avenue highway bridge over Frankford creek, Philadelphia, has plate girders 86 feet 8 inches long that weigh 39 tons each.

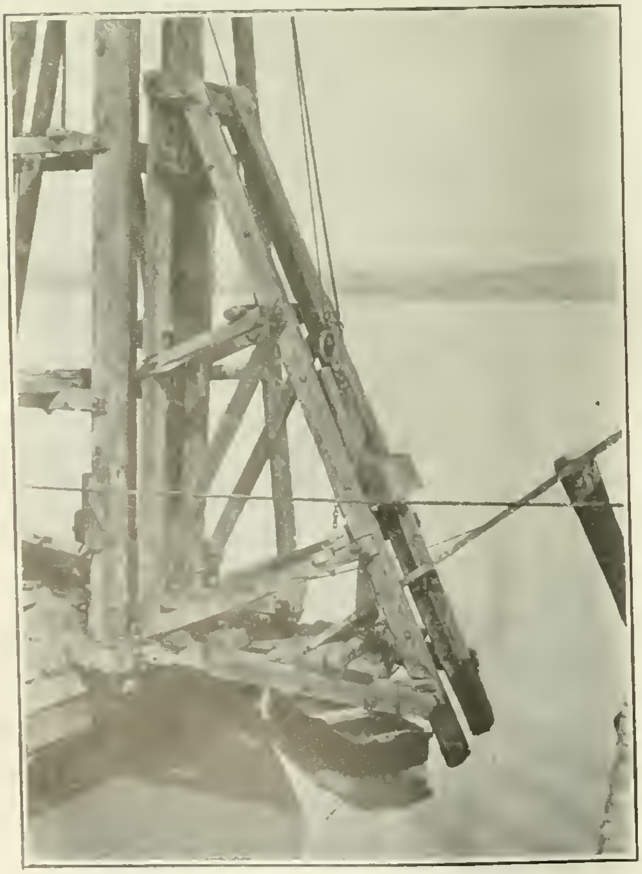
HANDLING LARGE GIRDER IN POSITION WHERE FLANGE HOOKS WERE IMPRACTICABLE

They are connected by plate girder floor beams 51 feet long.

The girders were hauled to the site with the webs horizontal, supported on bolsters on the axles of two independent trucks hauled by a steam tractor. They were unloaded by a steel derrick of 30-ton nominal capacity that had one steel stiff-leg and one wooden stiff-leg and was rigged with a 9-part hoisting tackle and a 9-part topping lift, both rove with steel wire rope.

In lifting the girder from the trucks it was attached to the hoisting tackle by a pair of heavy chain slings passed around it, one at each side of the center of gravity and enabling it to be picked up flatwise and laid down on temporary support after which the slings were disconnected and the girder revolved into a new position with the web vertical. This position enabled the slings to be replaced by a pair of clamped plate hooks engaging the upper flange at the center of gravity.

The girder was then carefully shifted and swung to position on the abutment with the derrick boom at an angle of about 45 degrees with the vertical, care being taken to watch it closely for signs of incipient failure from the overload. None were observed, however, the girders were safely lowered to position without difficulty. The boom was swung by a line attached to the point, run through a snatch block, anchored to the abutment at the opposite side of the girder and then led to the hoisting engine. The girders were fabricated and erected by the American Bridge Co., J. B. Gimberling, division erection manager.


DETACHABLE INCLINED WAYS FOR DRIVING SPUR PILES, WOOD ISLAND BULKHEAD

Wood Island Bulkhead

More than 1,000 battered piles and nearly as many vertical piles driven 16 feet in hard clay with three floating drop-hammer machines in Boston harbor.

The improvements at Wood Island park, in the harbor at Boston, are being carried on under the direction of Frank W. Hodgdon, chief engineer of the Division of Waterways and Public Lands, Department of Public Work, Commonwealth of Massachusetts, and include the construction of a long wooden bulkhead built by the William L. Miller Company, contractor.

The bulkhead, 2,500 feet long, is required to retain a hydraulic fill 16 feet high above low water level. It is therefore designed to resist a heavy horizontal thrust that is received against the vertical face of a continuous line of 4-inch wooden sheet piles bolted, as shown in the engraving, to rangers on vertical wooden piles 6 feet apart on centers that are driven to a penetration of about 16 feet in the hard clay bottom.

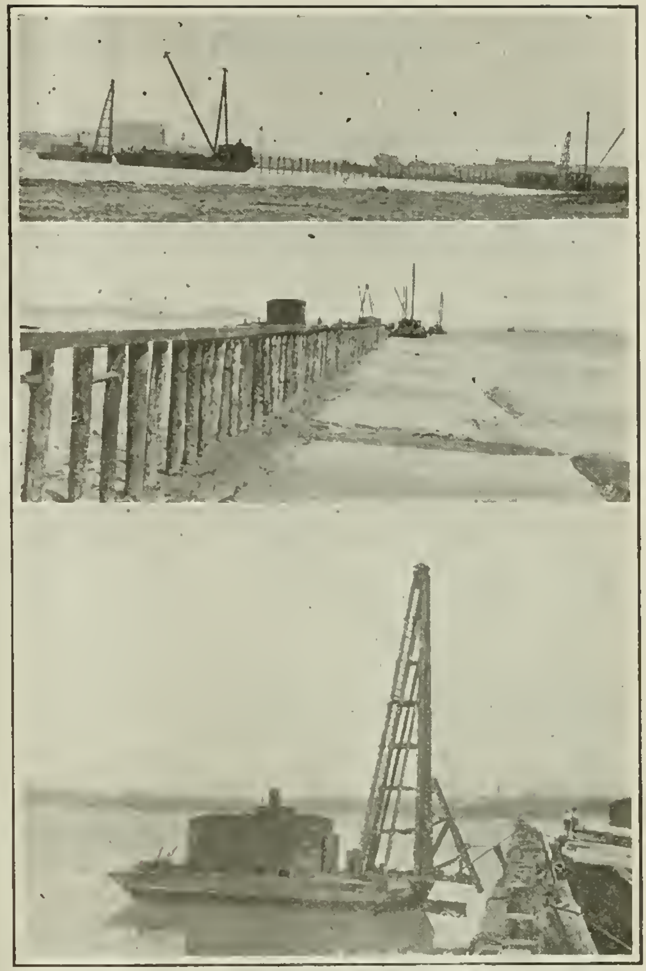
Where the elevation of the bottom is 5 feet or more above low tide, the vertical pile is braced only by a single battered pile, but if the elevation at the bottom is lower, a greater portion of the vertical pile is exposed, the bending moment and horizontal thrust are greater and the pile is braced by two battered piles, as shown in the diagrams.

There are in all about 2,122 piles required, which were delivered by rail and loaded on lighters in lots of about 250, or 5 carloads each. They are all of oak from 6 to 14 inches in diameter and from 30 to 40 feet long. The vertical piles were first driven at the rate of about 36 in six working hours by an ordinary floating machine with 60-foot leads and a 2,400-pound drop-hammer.

After the piles were capped and adzed to receive the battered piles, another one of two floating driver machines handled the piles from the attendant lighter and, resting them on top of the cap piece, spotted and drove them at about the same rate as the vertical piles, with the drop-hammer operating in a pair of inclined ways 15 feet long, framed to slide up and down in the vertical ways of the original machine. The vertical piles were lined in with shore ranges, and measured for position in the ordinary way, and the entire work of framing and driving was done by a force of about 30 men operating the three machines and framing and bolting the piles.

After the battered piles were driven to approximate position and cut off and adzed to the required angle, they were pulled up against the faces of the vertical piles by lines operated by the hoisting engines of the pile driver machines and held there while the bolt holes were bored with augers operated by machines furnished by the Chicago Pneumatic Tool Company and driven with compressed air provided by an Ingersoll-Rand compressor. Each joint is made with two 1¼-inch bolts, having flat washers bearing on notched surfaces.

At the point where the work was done the ordinary variation of tides was about 10 feet and as the draft of the pile driver scows is more than 4½ feet and that of the lighters is 6 feet, there were portions of the day when neither pile drivers nor lighters could be moved, thus considerably retarding the work and destroying it's continuity.


DRIVING VERTICAL PILES
CAPPING VERTICAL PILES
DRIVING INCLINED PILES

Important Labor Attitude

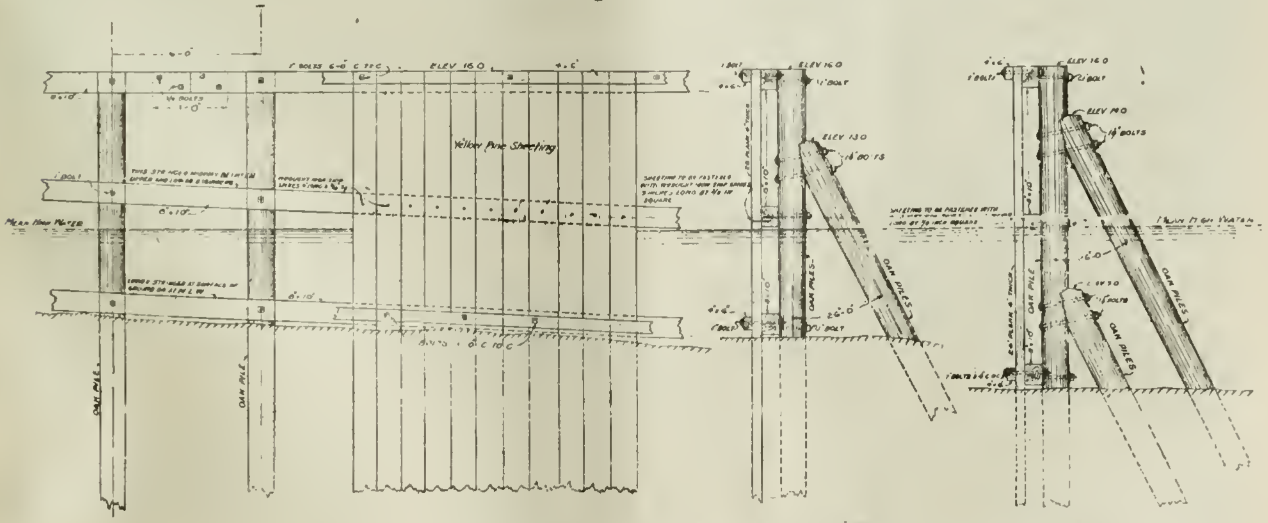
The new constitution adopted July 29 by the Loyal Labor Legion of New York City is so different in fundamental principle from the common practice of the A. F. L. unions that it should arouse great interest and hopes for important good results in that it specifically upholds basic principles that have in practice, and some of them in terms, been opposed by the unions but which are vital to real democracy and liberty.

In particular the new constitution recognizes: (1) The right of men and women to work regardless of membership or non-membership in trade unions. (2) The rights of the general public as a party at interest in labor controversies. (3) The necessity for laws establishing courts of arbitration, with power to enforce obedience to their decision. (4) The settling of differences between employers and wage earners "without intervention by persons not personally affected by or direct parties to the matters in controversy."

A committee has been appointed to inform trade unions throughout the country of the new principles laid down in the constitution and to devise methods for bringing organized labor into line for their acceptance.

The new organization should wield a strong influence among the labor unions from the fact, as stated by its head, F. Paul A. Vacarelli, former vice-president of the International Longshoremen's Association, that the committee appointed to frame the new constitution was composed of the chairman of the International Union of Steam and Operating Engineers, president of the Loyal Labor Legion and president of the Scow Trimmers' Union, secretary of the Harbor Boatmen's Union, chairman of the American People's League and members of the International Longshoremen's Union and Amalgamated Association of Street and Electric Railway Employees.

It is also stated authoritatively that 90 per cent of the organization's membership is composed of elected officials of American Federation of Labor trade unions, representing a membership of more than 20,000 in New York City.



ELEVATION

SECTION THROUGH BULKHEAD WHERE ELEV. OF BOTTOM IS 5.0 OR ABOVE

SECTION THROUGH BULKHEAD WHERE ELEV OF BOTTOM IS BELOW 5.0

BRACED SHEET PILE BULKHEAD RETAINING DEEP FILL

Recent Legal Decisions

SUFFICIENCY OF NOTICE OF BIDS FOR STREET GRADING CONTRACT

On appeal from the levy of an assessment for grading a street objection was made that the notice of bids for the grading contract was insufficient. The Iowa statute relied upon, Code Supplemental Supp. 1915, par. 813, provides that the notice shall state as nearly as practicable the extent of the work, etc. It was argued that the notice did not do this, since it did not state the extent of the haul necessary in removing surplus dirt or making a fill. The court said that the notice did state the amount of excavation estimated, and in the assessment the same number of cubic yards stated for grading was charged for and assessed. Thus the extent of the work was given. The matter of hauling would be one of the details as contended; but in Nixon v. Burlington City, 141 Iowa 316, 323, 115 N. W. 239, 18 Ann. Cas. 1037, the same court held that it was not necessary that the notice state all the details, and that its office is to apprise the public and persons interested of its general character, and to give opportunity for investigation and protest to those desiring to make it.

The statute also requires the notice to state the terms of payment. It is held this was sufficiently done by reciting in the notice that the cost was to be assessed against the abutting lots in accordance with the law governing the same and that the payment was to be made in assessment certificates or bonds. Royal v. City of Des Moines, Iowa Supreme Court, 182 N. W. 188.

DELAY OF CONTRACTOR IN SECURING EXTENSION OF TIME CURED BY STATUTE

In an action by a contractor to foreclose an improvement assessment, the California Supreme Court holds, Oakland Paving Co. v. Whittell Realty Co., 195 Pac. 1058, that a failure to secure an extension of time on the exact day when the contract expired, or before, is a mere defect or formality in the proceedings, where the contractor has been proceeding diligently day after day as the law and contract provide, and has failed to complete the work within the time which was fixed after his bid to do the work had been accepted, and the informality comes within section 26 of the California Improvement Act, 1911, providing that no proceeding prior to assessment shall be held invalid for any informality in it.

CITY MAY AGREE WITH STREET RAILWAY TO PAVE LATTER'S PORTION OF STREET

When an electric railway company, exercising an easement in a city street about to be repaved and being liable by law and under the terms of its franchise for the cost of paving the part occupied by it, proposes that the city pave the railway's part along with the remainder of the street, agreeing to pay its proper proportion thereof, including the preliminary cost of surveys, etc., upon the same terms as special assessments against abutting property are made payable, the Ohio Supreme Court holds, City of Newark v. Fromholtz, 130 N. E. 561, that the city may accept such proposal and proceed accordingly. Such action is not unconstitutional.

ABUTTING OWNER CANNOT ENJOIN REMOVAL OF RAILROAD TRACKS FROM STREET

In a suit by a taxpayer to restrain the execution of a contract between a city and railway companies for the removal of railroad tracks from a street in the city, with which tracks the plaintiff, whose property abutted on the street, had switching connections, the Supreme Court of the United States holds, Armour & Co. v. City of Dallas, 41 Sup. Ct. 291, that such owner has an adequate remedy at law by the recovery of damages to his property caused by the removal of the tracks, and that the bill for injunction was therefore properly dismissed.

CONTRACTOR CONTRACTING TO REMOVE LOOSE MATERIAL ENTITLED TO EXTRA COMPENSATION FOR ROCK WORK

The Supreme Court of the United States holds, United States v. L. P. & J. A. Smith, 41 Sup. Ct. 413, that a contractor which contracted with the federal government to remove clay, sand, and boulders from a navigable stream, is entitled to extra compensation for the removal of a bed of limestone rock, notwithstanding provisions making the decision of the officer in charge of the work as to the quality and quantity of the work final, and requiring his instructions to be observed by the contractor, and the fact that the engineer ordered him, despite his protest, to remove the rock under the contract.

REQUIREMENT AS TO COMPETITIVE BIDDING MUST BE COMPLIED WITH

In a suit by a city to compel specific performance by a lighting company of its contract with the city, it appeared that the company's street lighting proposal was accompanied by an offer, contingent upon the acceptance of the street lighting bid, to supply commercial lighting and power to the city and its inhabitants at certain reduced rates during the life of the street lighting contract, which was accepted by the city for itself and its inhabitants. The city charter, however, required competitive bidding for the letting of contracts for the expenditure of over $250, and since the commercial contract as respected the city called for an expenditure by the city of more than $250 per month, it violated the competitive bidding requirement, and did not bind the city. The city, therefore, not being bound, could not, by bill for performance, City of Saginaw v. Consumers' Power Co., Michigan Supreme Court, 182 N. W. 146, compel the company to perform the contract as to it, in view of such lack of mutuality of obligation. The city, however, might maintain the bill on behalf of its citizens and the consumers of commercial light and power, to avoid a multiplicity of suits.

NEWS OF THE SOCIETIES

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference. Hotel La Salle, Chicago, Ill.

Aug. 23-25—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS Annual meeting. Detroit, Mich. Secretary, Emmet P. Griffin, Superintendent of Park, East St. Louis, Ill.

Aug. 30-Sept. 1—MICHIGAN STATE GOOD ROADS ASSOCIATION. Annual meeting. Flint, Mich.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventth annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 5-7—SOCIETY OF INDUSTRIAL ENGINEERS. National convention. Springfield, Mass.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The Metropolitan section of the society, with a membership of 3,000 has elected W. S. Finlay, Jr., chairman; G. I. Rhodes, secretary; and Robert B. Wolf, treasurer, with A. E. Allen, of the Westinghouse Company, constitute the executive committee.

The Metropolitan section, under which are held public forums on engineering topics, has sub-committees on power engineering, industrial relations, educational manufacturing, production engineering and legislation.

The American Society of Mechanical Engineers announces the appointment of a new committee on relations between general meetings, professional divisions and local sections. The members are L. P. Alford, of New York, editor of *Management Engineering*; Dean Dexter S. Kimball, of Cornell; Professor W. B. Gregory, of Tulane University; J. H. Herron, of Cleveland; and G. A. Orrok, J. W. Roe and H. A. Reed, of New York.

FEDERATED AMERICAN ENGINEERING SOCIETIES

The Federated American Engineering Societies, created in the latter part of 1920, promptly appointed a committee of 18 distinguished engineers to undertake the study of the restrictions and wastes in industry. The essence of the plan was to gather quickly such concrete information as might be used to stimulate action and to lay the foundation for other studies. Within five months the committee completed an analysis of waste in 6 typical branches of industry and on June 3 presented a summary of its findings to the American Engineering Council. The industries studied are of various character and enormous output and were found to have very large wastes, which the committee believes exist in other industries that, when investigated, will prove to be preventible and traceable to the same causes.

The investigation was carried out systematically on rational lines by use of an elaborate questionnaire containing 25 large pages of classified guide questions for the field workers, which assured to a considerable degree its uniformity of method and result. On this basis 50 engineers spent approximately two months each in securing information upon which the reports were based that have been submitted to engineers or others having particular knowledge, for constructive criticism and suggestion.

The investigation clearly indicates that industrial waste is caused, not only by failure to use the time and energy of the men, but also from failure to use productive equipment. Therefore to eliminate waste, more must be accomplished in the same time, or the same accomplished in less time.

There are nearly 300,000 industrial plants in American industry divided by the census into 14 major classes, and a group of representative plans in each of six classes was studied. The branches of industry already investigated are Buildings, Clothing, Shoes, Printing, Metal Trades and Textile Manufacturing. The complete report will comprise Section 1, summary of detailed reports, now just released: Section 2, engineers' field reports; and Section 3, general reports. The investigation has been carried through at cost or less and should be of great intrinsic value for the practical data secured and also potential for the inception and development of future investigations of the highest importance.

PERSONALS

Briggs, B. A., has been appointed on the Colorado State Highway Department.

Middleton, Ellis G., is now connected with the Highway Commission of West Virginia.

Gallagher, R. O., is resident engineer for the Tennessee Highway Department on the construction of a federal aid road between Mountain City and Bristol.

Freeman, Dr. A. W., will become resident lecturer on public health administration, Johns Hopkins School of Hygiene and Public Health, Baltimore.

Galvin, John F., Richmond, Cal., has been made secretary of the California State Highway Commission.

Snyder, D. D., commissioner of Public Works of Rutland, Vt., has joined the Frissell Engineering Co., Gardner, Mass.

Kent, E. S., has opened an architect's office at 72 Webster avenue, Bangor, Me.

Davies, C. E., has been appointed managing editor for the publication of the American Society of Mechanical Engineers.

Hicks, Joshau, has been appointed water, light and sewer commissioner of Wymore, Neb.

Costello, James W., an engineer in the department of streets and public improvements of Newark, N. J., has been appointed general supervisor of the bureau of docks.

Horridge, John, of Philadelphia, Pa., has been appointed supervising engineer in the division of street cleaning, department of public works, Philadelphia.

Morse, Fred S., has been appointed city engineer of Springfield, Ill.

McDougall, Alex, has been appointed to valuate the plant of the Ottawa Electric Co.

Cauchon, Noulan, submitted to the Hamilton Harbor Commission a project for the purpose of effecting an improvement in the proposed harbor scheme.

Gardner, J. C., has been appointed city engineer of Niagara Falls, Ont.

W. C. Morse has opened offices in Seattle, Wash., for the practice of general engineering and contracting work.

E. W. Verity, Jr., has been made construction manager of the Admiral & Co.'s New York office and Carl H. Sanborn of the Boston office.

W. C. Morce has opened a contracting engineering office in Seattle, Wash.

F. A. Forkelson has been placed in charge of the road construction and structural steel work of the Randolph M. Hansen Co., of Green Bay, Wis.

H. E. Heilman has been appointed in charge of the Detroit office of the Joseph L. Skelton Engineering Co., at 1156 Penobscott building.

John A. Conboy Co. has opened offices in Philadelphia, Pa.

McClure-Green Engineering Co., 612 Park building, Worcester, Mass., will specialize in municipal engineering.

Stanislaw Ducharme has been appointed a member of the Board of Water Commissioners of the City of Chicopee, Mass.

J. O. G. Gibbons and C. F. Brown have opened a consulting engineering office in Newark, N. J., and will specialize in power plants and industrial problems.

Chalmers, G. H., has been appointed resident engineer for the construction of extensions to the water works system of St. Thomas, Ont.

Catlett, George F., has been appointed principal assistant engineer of the Bureau of Engineering, North Carolina State, Board of Health.

Givan, Albert, has been appointed city engineer of Sacramento, Cal.

Ballew, Ralph D., has been appointed city manager of Grand Rapids, Mich.

Maxwell, W. D., has been reappointed county engineer of Sac county, Iowa.

Morse, S. T., city engineer of Carlinville, Ill., was killed in an automobile accident on June 3.

Hunt, A. L., county engineer, Baker county, Fla., died July 4 at West Palm Beach.

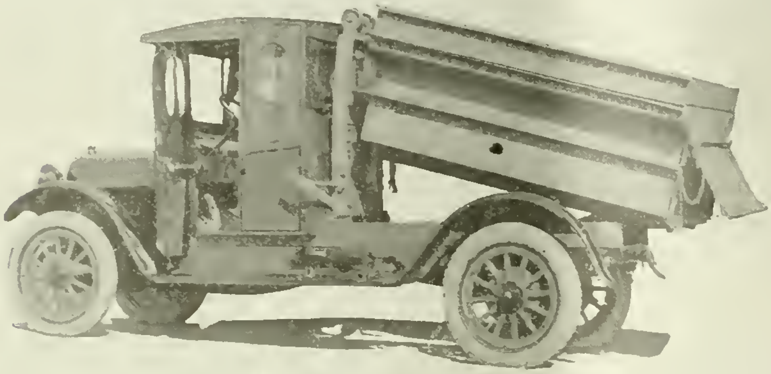
Pope, Geo. W., contracting structural engineer, Minneapolis, Minn., died on July 9.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

YULE DUMP BODIES AND HOISTS

The Yule steel bodies made by the Way Products Co., and especially built for the Reo speed wagon chassis, are designed to provide an indestructible general purpose body of sectional construction with straight sides, double-acting tail gate, equipped with spreading device and extension side boards that may be used as a dumping unit or as an express or stake body.



YULE THREE-SECTION STEEL TRUCK BODY EQUIPPED WITH YULE HOIST

The 3-section body, model 12, designed for coke, ashes, garbage, snow and other light materials has a water measure capacity of 80 cubic feet or for 1 ton of coke. By unbolting and removing its upper section or course, the body becomes model E1 with a water measure capacity of 60 cubic feet or 1½ tons of bituminous coal, and by unbolting and removing the second section the lower part only remains, forming model 012 with a capacity of 27 cubic feet or 1 yard of gravel or with extension sides 40 cubic feet water measure.

When equipped with the Yule hoist the body, loaded to capacity, may be elevated by hand to an angle of 50 degrees and dumped in less than a minute, the elevation of the body is sufficient for the quick and complete discharge of almost any contents, and it may be held safely in any position by a ratchet. The hoist, which weighs 265 pounds, when mounted occupies less than 12 inches space in the rear of the driver's seat, will fit any chassis and may be installed easily and quickly without drilling a hole. All gears are concealed and there are no parts to break or get out of order.

10,000-POUND GASOLENE WAGON LOADER WITH CREEPER EQUIPMENT AND FEEDING PROPELLERS

HAISS CREEPER EQUIPPED PATH DIGGING WAGON LOADER

These machines are claimed to be the lowest in first cost and the cheapest in operation for handling crushed stone, coke, sand, gravel, and, in fact, any friable material that will pass through a 4-inch ring and that weighs not more than 125 pounds to the cubic foot. They are particularly adapted for digging and loading material from sand and gravel banks and for use on soft ground.

For road construction they can be equipped with hoppers holding 27 cubic feet. These loaders, when equipped with hoppers, are particularly used for loading motor trucks with Lee bodies or Tructractors.

If it is desired to load feeding belts to the concrete mixer, the Haiss creeper-equipped path digging wagon loaders can be furnished with swivel or side discharge spouts, whichever is the most adaptable for the particular conditions encountered.

The engines used are 37 h. p. Waukesha gasoline engines with Dixie magneto, Zenith carburetor and Bennett air cleaner. The creepers are 8 feet long, 10 inches wide, and are made of cast steel links connected with high carbon steel pins. The weight of the loader is 10,000 pounds, which gives a bearing pressure of less than 7 pounds per square inch on the ground.

This loader is equipped with the Haiss patented feeding propellers which are a positive drive and do not depend upon the cohesion of the material to feed itself into the buckets. The loader is also equipped with a patented slow-speed worm gear which crowds the machine into the material 30 inches a minute, simultaneously with the digging motion. This crowding action working with the feeding propellers, forces a constant flow of material in front of the buckets of the loader.

The width of the creepers overall is 6 feet and the cutting width of the feeding propellers is 7 feet, allowing a 6-inch clearance on each side of the loader for digging its way back into the pile.

INDUSTRIAL NOTES

The Link-Belt Company, Chicago, has just acquired all of the capital stock of the H. W. Caldwell & Son Company, which company will continue to operate under separate corporate existence and under its present name, with practically the same plant management. H. W. Caldwell has been elected a director of the Link-Belt Co.

The Conveyors Corporation of America announces the appointment of Robert B. M. Wilson as sales engineer of the Chicago district, with E. M. Wolfe as assistant.

The Dayton-Dowd Co., of Quincy, Ill., has opened a new district office in the Pioneer Building, St. Paul, Minn., for the sale of its pumping machinery, in charge of George M. Kenyon Co.

The Brown Hoisting Machinery Co., of Cleveland, Ohio, has opened an office in New Orleans, La., with Charles H. White as manager.

Leslie H. Allen, formerly with Fred T. Ley & Co., contractors, has been appointed assistant manager of the Cement Products Bureau of the Portland Cement Association.

John A. Conboy Co., a new sales organization handling contractors' railroad, mine and industrial machinery and equipment, have opened offices in Philadelphia, Pa.

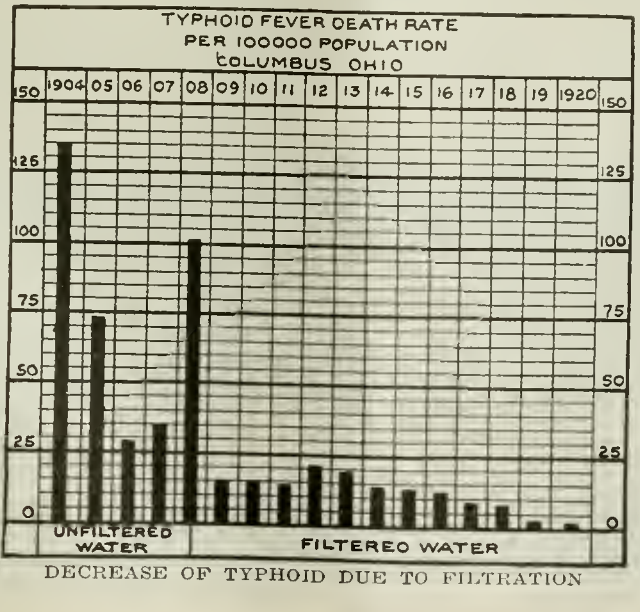
PUBLIC WORKS.
CITY COUNTY STATE
A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.
Vol. 51 AUGUST 13, 1921 No. 7

Water Softening and Purification at Columbus

Typhoid death rate reduced more than 90 per cent. Carbonate in softened water forms incrustation on filter sand. Experiments for preventing this have been tried out, and phosphoric acid seems to be the most promising.

Columbus, Ohio, is one of the comparatively few cities that soften their water supplies, and probably the only one that as yet uses phosphoric acid in connection with it, as it was, we believe, the first to manufacture its own lime and sulphate of alumina. For both of these innovations credit is due to Charles P. Hoover, chemist in charge of the water purification plant.

The city obtains its supply from Scioto river, which is dammed about five miles above the city. This water is very hard, the average for twelve years having been 160 parts per million and the hardness at times reaching 300 or more. It is also very muddy at times; after heavy rains as much as 125 tons of mud are removed from a single day's supply of water. It receives sewage pollution also, and in 1904, the year before work was started on the filtration plant, the typhoid fever death rate was 139 per 100,000; and during 1920, of all the 1 c. c. confirmatory tests of the river water for B. coli, 58.5 per cent were positive, and 96.3 per cent of the 0.1 c. c. tests, and the average number of bacteria in the river water during the year was 2,400 per c. c. By filtration the number of bacteria was reduced to an average of 19, and the turbidity was continuously zero, while by softening the hardness was reduced from an average of 266 to 109. The typhoid death rate was 2.5 per 100,000, a total of six deaths, of which five were non-residents.



DECREASE OF TYPHOID DUE TO FILTRATION

Lime and soda ash are used for softening, and alum as a coagulant. The water, after receiving the chemicals, travels about a mile over and under baffles in the mixing chambers in a period of about two hours. It has been the practice at Columbus to leave between 25 and 40 parts per million of incrustant hardness in the water. During 1920 the quantity of sulphate of alumina used varied from 11.3 grains per gallon to 0.4 grain, averaging 2.3 grains.

SAND INCRUSTATION

The normal carbonates present in the lime-softened water form incrustations on the sand grains in the filters, thus increasing the size of the sand grains and causing them to become cemented together, forming hard lumps. This condition became so bad in June, 1919, that the initial loss of head averaged 4.4 feet during the month and the average initial loss of head of the filters for the last six months of 1919 was 5.6 feet, the final loss during this period having been 12.2 feet.

The average initial loss of head during the year 1920 was 6.2 feet, and the final loss was 8.6 feet. The average initial loss of head became low in September, owing to the putting into operation of some re-sanded filters. By January 1, 1921, nine of the ten filters had been re-sanded and put back into operation.

After removing the sand and gravel from one filter it was found that the holes in the strainer plates were stopped up with carbonates; this also being a contributing cause for the poor operation of the filters. With the wash-water valve wide open the greatest vertical rise possible to obtain was 12 inches.

The strainer plates were all taken out and four ¼-inch holes drilled through each one. (There were originally 45 holes 1/16-inch in diameter.) The total area of the ¼-inch holes in the strainer plates in one filter amounts to 2.79 square feet, or 0.26 per cent of the filtering area, while the total area of the 1/16-inch holes was 1.96 square feet, or 0.18 per cent of the filtering area. With the larger openings it is possible to obtain a vertical rise of 22 inches, but on account of the capacity of the wash-water troughs the re-built filters are being washed with a vertical rise of 18 inches.

The strainer plates in the re-built filters are covered with 16 inches of gravel of the following grades, the dimensions being the diameters of circular screen openings: 5 inches of 2½ to 1½-inch gravel, 3 inches of 1½ to 1-inch, 2 inches of 1 to ½-inch, 2 inches of ½ to ¼-inch, ¼-inch of fine pea gravel and 24 inches of sand with effective size of 0.38 mm. About $20,000 is being spent in re-building the filters.

Owing to the incrustation, the sand had increased in effective size from 0.42 mm. to more than 1.0 mm. The first investigations toward working out a practical method of eliminating the difficulties were along the line of colloidal chemistry. Early experiments indicated that the solubility of calcium carbonate depended upon whether it was precipitated in a crystalline or colloidal condition. Calcium and magnesium carbonates in the former state are soluble to the extent of thirty-seven parts per million, whereas the colloid of these carbonates is soluble to more than 100 parts and colloidal precipitates form when the water is high in magnesium, or is muddy.

In order to produce a lime-softened water that would be stable, the first method which suggested itself was to carbonate the water with CO_2. There are a number of ways that the carbon dioxide may be produced, but the ones which were given particular attention were as follows:

(1) Burn the lime sludge from the settling basins, producing lime and CO_2.

(2) Treat the lime sludge from the settling basins with sulphuric acid, producing calcium sulphate and CO_2.

(3) Calcine sodium bicarbonate, producing sodium carbonate and CO_2.

(4) Treat soda ash with sulphuric acid, producing sodium sulphate and CO_2; then roast the sodium sulphate in a furnace with slack coal and limestone, producing sodium carbonate, which could be used in softening.

By carbonating the water, the normal carbonates are put in solution and there is no reduction of hardness. Under normal conditions this objection is not so serious, but during certain periods of the year when the precipitates of calcium and magnesium are necessarily colloidal, causing the alkalinity or temporary hardness of the softened water to be high, it is desirable that these carbonates be removed by precipitation, thus reducing the hardness of the water rather than be dissolved by carbonation and leaving the hardness unchanged.

Experiments were also conducted to determine the advisability of neutralizing the normal carbonates with sulphuric acid. This was effective, but was more objectionable than the carbonic acid because by this process temporary hardness is converted to permanent hardness.

Silicic acid was tried but the results were not very promising. However, excellent results were obtained by filtering lime-softened water through porous silica gel as prepared by Dr. W. A. Patrick, Johns Hopkins University.

Boric, oxalic acid, tartaric acid, and phosphoric acid were next tried and a great deal might be said of the results obtained by each of these acids, but the final conclusion arrived at was, that as a finishing treatment for lime-softened water the phosphoric acid was the best and the most economical treatment tried. When enough phosphoric acid is added to lime-softened water to combine with any caustic alkalinity that might be present in the water, and with one-half the normal carbonates of calcium and magnesium, a reaction results which produces tri-calcium phosphate, which is insoluble and readily settles from the water and CO_2 which carbonates the remaining quantity of normal carbonates. By this process half of the carbonates are removed, thus reducing the hardness of the water; the balance of the carbonates are carbonated, thus producing a water that is stable.

In coagulating muddy water, such as the Scioto river water during flood times, better results are obtained with coagulants when the water is treated with enough lime to soften the water and an additional amount is added sufficient to give the water a caustic alkalinity. This caustic alkalinity must be neutralized before the water is filtered, and phosphoric acid can be used for this purpose also.

Phosphoric acid is being tried out now on a large scale. Tennessee rock phosphate is used to make the phosphoric acid. It is boiled with sulphuric acid in one of the alum-boiling tanks, and phosphoric acid and calcium sulphate are produced. The latter is practically insoluble and separates from the solution, leaving a clear phosphoric acid which is fed into the water at the rate of about 0.7 grains per gallon.

LABORATORY TESTS

The city maintains a complete chemical and bacteriological laboratory at the water purification plant, where the water is tested, chemically, every two hours, day and night, Sundays and holidays, and bacterial analyses are made daily on samples collected at the plant and from different points on the distributing system. Daily bacteriological tests are also made in the laboratory of the Ohio State Board of Health and at the City Board of Health. There is a chemist to control the operation of the plant and attendants for plant operation on duty every hour of the day and night.

Many of the time-consuming analytical determinations which are made daily at many water purification plants have been eliminated at the Columbus water softening and purification plant, because Mr. Hoover believes that only such tests as give assurance of the purity of the water and assist in properly treating the water should be made a part of the routine schedule, and that such tests as nitrogen, free and albuminoid ammonia, nitrates and nitrites, and the determination of dissolved oxygen, oxygen consumed, and complete mineral analysis serve to advantage only in special cases.

The analytical data necessary to determine approximate quantities of lime and soda ash required to soften a hard magnesium water, such as the Scioto river water, are:

Free CO_2.

Half bound CO_2 (44 per cent of the alkalinity).

Total magnesium.

Permanent hardness or incrustants.

The methods of analysis used are the Standard Methods of Water Analysis of the American Public Health Association.

During the year 1920 the total consumption was 8,275 million gallons (calculated from pump counters with 1 per cent allowance for slip), giving 94 gallons per day per inhabitant, or 97.8 per consumer. The cost of supplying water per million gallons pumped, on basis of total operating expense, was $64.09, or $89.46, including interest on bonds and sinking fund charges. The cost per million gallons pumped was $19.45 for chemicals for purifying and softening, $8.81 for coal at the pumping station, and $29.09 for labor for operating and maintaining the entire plant. The total cash receipts from all sources was $92.89 per million gallons pumped. The average net amount received for water per service was $18.35 and the average total cost of operating plant plus interest on bonds and sinking fund charges was $19.21 per service.

The total cost for purification and softening was $221,438, of which $170,745 was for materials and $50,693 for labor, and $19,039 was spent for construction in connection with the same.

Clinton Bridge

A state highway bridge at Clinton, Conn., has three 40-foot spans and two 16-foot end spans of concrete T-beam construction, supported on concrete pile trestle bents. The outer edges of the outside sections of the floor slabs are moulded to give the effect of fascia girders and form a suitable base for the concrete parapets which form continuous handrails or ballustrades on them.

The floor slabs are supported on the transverse concrete caps of trestle bents, composed of a pair of cast-in-place concrete piles, 16 inches in diameter, which are of special construction in order to secure protection against the action of the salt water in which they are immersed.

The bents are located in shallow water in which the bottom was dredged to provide a satisfactory regular horizontal surface to receive extended footings. Each trench was enclosed with a simple cofferdam sufficient to protect the interior from the effects of tide and current, but was not watertight. In it there was deposited under water a concrete footing 2 feet thick and before this had set there was placed at each end of the footing a section of 36-inch tile pipe bell end down, and penetrating slightly below the surface of the soft concrete. This pipe was used as a form and was filled with concrete, after which a second length of pipe, bell down, was placed on top of it, concreted, and so on, until the pile was built up to the required height.

The arrangement with the bells down provided a slightly larger base on the footing and prevented any accumulation of salt water in the bells. The pipes served not only as convenient sectional forms, but are also permanent protection against action of salt water on the concrete.

The bridge was built by John D. Holbrook, contractor, under the direction of the Federal State Highway Commission.

THREE 40-FOOT REINFORCED CONCRETE GIRDER SPANS ON CAST-IN-PLACE CONCRETE PILE BENTS

To Clean Up Elizabeth River

Elizabeth river, where it flows through Elizabeth, N. J., has been growing increasingly obnoxious for several years past, due to the decomposition of sewage matter which is discharged into it from the city sewers and also to the presence of oil and other offensive matters originating on abutting properties. James H. Fuertes has recently submitted a report to the Board of Works of that city on the abatement of these nuisances, recommending the expenditure of $3,877,000 for both immediate and future construction.

The immediate steps recommended are constructing two intercepting sewers at an estimated cost of $20,300, dredging sewage sludge from the river bottom at an estimated cost of $16,500, and making some changes and extensions in the sewerage system at an additional cost of about $10,000. Ordinances preventing pollution of the river by oil and other commercial wastes should be passed and enforced.

Work which should be performed from time to time in the future include widening the river at many points and especially between bridge abutments by lengthening the bridges; separating the storm sewage from house sewage, and regulating all future sewer construction to provide for ultimate treatment of the sewage and obtaining a site for a sewage treatment plant.

The condition in the river is aggravated in warm weather by the fact that the Elizabethtown Water Company, during dry periods, uses practically the entire flow from the river. Last summer there were ten days during which no fresh water flowed below the dam and twenty-four days during which the flow was less than 1,000,000 gallons a day. As the sewage flow of Elizabeth is about 14,000,000 gallons a day, the flow of the river furnished practically no dilution. The object of the sewers recommended by Mr. Fuertes is to carry all of the putrescible matter to an outlet below the city, ultimately treating all sewage before discharging it into either the river or Newark Bay. Up to the time of this writing no action had been taken for an immediate carrying out of any of these recommendations.

Gate Valve Controls in Cambridge

The Cambridge, Mass., municipal water works pumps water from Fresh Pond through a 40-inch force main to a reservoir from which a 40-inch main supplies the distribution system. There is also a 36-inch main by-passing the reservoir to the distribution system.

As is the case in most other cities, the large 40-inch and 36-inch valves on these lines have seldom been operated and receive little attention, and General Superintendent Timothy W. Good, to whom we are indebted for this information, says that: "Experience shows that on former occasions when it was necessary to shut down, it took eight men three hours to close these valves."

Recently, the city installed three gate valve controls on the valves on these lines. "By pressing a button on our new system we have our force main gate and our distributing main gate closed, and our connecting gate opened, all in a period of seven minutes. . . . The gates were installed at this particular point so as to control our entire system in case of emergency. If any trouble occurs between this point and our reservoir, or our reservoir should start leaking or be shut down for any other cause, we could immediately close the force main, close the distributing valve, open our 36-inch connecting gate and send the water direct through our system."

The city expects in the near future to have every gate more than 20 inches in size electrically operated, and is preparing a contract with the Payne Dean Co. for equipping four more of the large gates at once. Says Mr. Good: "I feel that it is money well expended, as when emergency now arises we know that considerable damage could be done during the time it takes to close the valves, which have not been operated recently, but with electrical control and proper inspection system of same, all water can be shut off from any section of the city in five to seven minutes.

"Of course, these electrical devices must be properly cared for and I have instituted a system of weekly inspection by our engineer and foreman and close these three gates at least once a week. I would say that they are working perfectly and I would be very glad to recommend them for use in any water department."

The Construction Industry*

The national wealth of the United States in 1920 is authoritatively estimated at about $290,000,000,000, of which the two largest items are about $169,000,000,000 value of real property and $20,000,000,000 the interstate commerce commission valuation of railroads and equipment, besides which there are about $7,000,000,000 for street railways, about $2,000,000,000 for telephone and telegraph systems, a little more than $2,000,000,000 for shipping and canals, and $3,248,000,000 for privately owned central electric light and power stations.

The 266,000 miles of railroads represent construction costs of about $15,000,000,000, the 80,000 miles of pavements and highways in cities cost about $4,000,000,000 and the estimate for highway construction during 1921 alone is more than $1,000,000,000.

An analysis of the United States government's figures indicate that construction represents 25 per cent of the total national wealth, 25 per cent of the 276,000 manufacturing companies that employ 10,613,000 workers to whom they pay more than $5,000,000,000 wages annually for the production of a $25,000,000,000 output.

Construction takes 90 per cent of iron, copper and lead output, 20 per cent of bituminous coal and 25 per cent of all freight. It requires 50 per cent of new capital issued, 24 per cent of annual capital accumulation and 50 per cent of national savings.

During 1920 nearly $3,000,000,000 of new securities were issued for construction without counting a large amount of construction that was financed out of any surplus without issuing securities.

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*Abstract of Report of Committee on Statistics of U. S. Chamber of Commerce.

A report of the Senate Committee of reconstruction and production estimates that from $10,000,000,000 to $20,000,000,000 is necessary to provide for structural facilities which would now be in use if there had been no war.

A present expenditure of about $35,000,000,000 would be necessary in order to develop our railroad system to serve each square mile of territory as thoroughly as is done in Germany and the United Kingdom. The necessity for enormous construction now exists and will continue for a long time.

Concrete Bridge Foundation Piles

CASTING REINFORCED CONCRETE PILES ON PLATFORM IN CONTRACTOR'S YARD

The pier foundations for the Washington bridge across the Housatonic river, between Milford and Stratford, Conn., are made with about 1,000 reinforced concrete piles, 14 inches square and averaging 40 feet in length, that support the footings concreted under water.

T. Stewart & Sons, contractors, West Newton, Mass., cast the piles in single tiers, on platforms 60 feet long at the river bank, near the bridge site. The vertical sides of the forms were set up on the smooth surface of the platform and between them were placed the reinforcement steel bars, assembled to form frames securely wired together and handled as units.

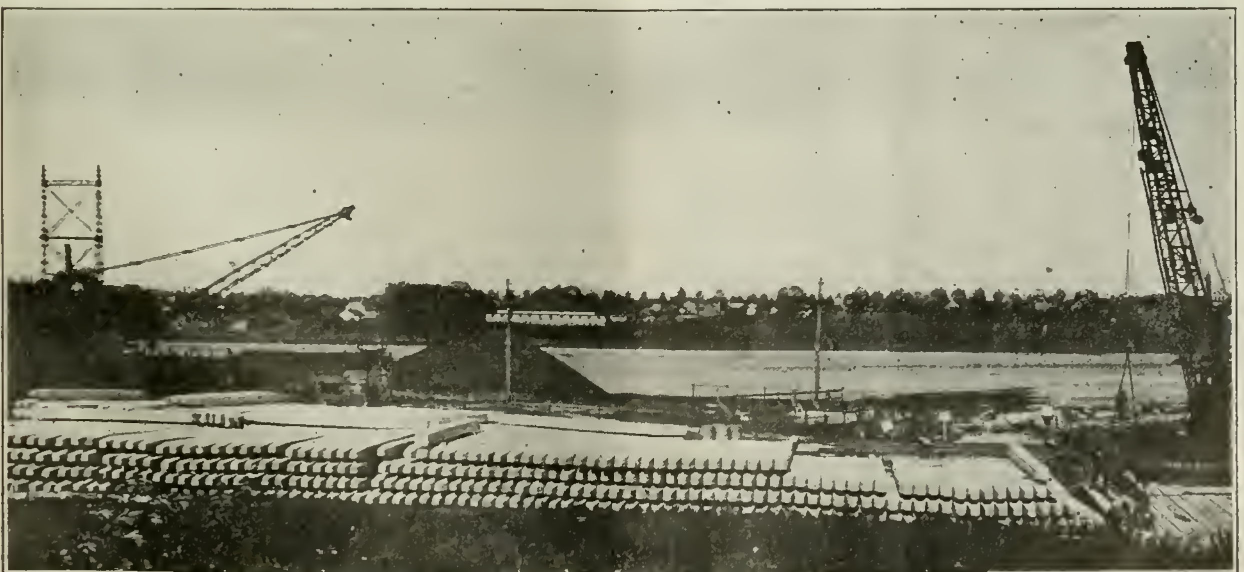
After the concrete was 6 or 7 days old the piles were stripped and carefully handled by a locomotive crane that transferred them to storage, where they were piled several tiers deep and left for a month or more before they were driven.

Steel staples with bent ends were cast in the upper surfaces of the piles, projecting beyond them to provide attachment insuring the connection of the hoisting tackles at the proper points. One was placed near each end of the pile and was quickly connected to the ends of a long evening bar, attached to the hoisting tackle of the crane. The lower ends of the piles were pointed and at the upper ends the dates and lengths of the piles were marked so as to be always visible when the piles were stored on the skids in the seasoning yard.

The piles were delivered on scows to the floating pile driver and were driven to an average penetration of about 40 feet through mud, earth and gravel, at a rate varying from 8 to 60 piles per 8-hour shift. A follower was provided for driving the piles below water surface. The bridge was designed and the work was done under the supervision of the State Highway Commission, Charles J. Bennett, commissioner, and R. L. Saunders, deputy commissioner, in charge of construction.

To Inspect New Jersey Dams

Official notice of the inspection of the dams of New Jersey was given July 26 by the State Department of Conservation and Development. Authority for this inspection and the control and regulation of all dams is given by the act of 1912. Heretofore the work has been limited by lack of funds. The appropriation for dam inspection and water supply investigation is $30,000.


STORING PRECAST FOUNDATION PILES FOR WASHINGTON BRIDGE

Alfred Gaskill, director of the department, has requested boards of freeholders to submit lists of dams which should have first attention. Obviously a state-wide inspection of all existing dams cannot be made at once, and these lists from the counties will enable the department to work to the best advantage and accomplish that which is most urgent in the shortest possible time.

Improving Building Construction

Annual losses of $500,000,000 in wages and of 12,000,000 days due to accidents should be largely eliminated, the union policies amended, work be better planned, and better co-operation secured between employers and employees.

The American Engineering Council has issued extracts from the report of its Committee on the Elimination of Waste in Industry, that emphasizes most of the troubles generally acknowledged, points out others not so well known, gives an authoritative estimate of their importance and suggests various rational methods of correcting the evils so as to vastly increase the amount, improve the conditions and promote the economy of general construction.

The report states that the primary causes of waste in the building industry are irregular employment, inefficient management, and wasteful labor regulation. Local customs, conditions and poor equipment are secondary causes.

Irregular employment is due to seasonal fluctuations, bad weather, strikes and lockouts. Obviously, arrangements should be made to perform indoor work as much as possible in stormy weather; to avoid exposed work in inclement weather; to distribute routine work as much as possible through the year; and to encourage winter construction by careful planning of methods and schedules, by co-operation with local transportation and material men, by co-ordination with labor, and by the acceptance of lower wages and smaller profits in return for the benefits of continuing operations during the winter and avoiding an idle season.

The strike is one of the greatest economic wastes in this industry and is generally caused by demands for increased wages or the recognition of the union, decrease in the working hours, and by jurisdictional disputes. In most cases the prime factor is the lack of understanding and failure of the employers and workers to get together. If the greatest cause, the demand for increased wages, could be eliminated, strikes would shrink into insignificance.

Co-operation between management and labor is necessary to determine a minimum wage to correspond with a standard amount of production with additional compensation for additional output. The union must co-operate to the extent of eliminating the flat rate for all mechanics of the trade and the restriction that forbids mechanics to accept piece work. Old methods should be replaced by new ones, definite records kept of accomplishment, and scales of wages based upon quality and quantity of work done and standards of a proper day's work should be established.

Inefficient management is due to failure to furnish continuity of employment; failure to plan work in sufficient detail; failure to provide detail plans in time; lack of proper schedules to allow co-ordination of purchasing and delivery to suit the job requirements; lack of standards; disregard or ignorance of high cost of labor turnover; or failure to use proper amount and type of equipment for operation.

Wasteful labor regulations consist of requiring men to do skilled work that could be performed by unskilled men, restricting individual incentive by uniform wages, limiting the number of apprentices, restricting output, excessive reduction of working hours, and jurisdictional restrictions.

Great direct and indirect injury is done the construction interests by accidents that destroy life and property and delay the work. Their cost, computed on the insurance alone, is 2½ per cent of the total labor cost and in some construction trades rises to 10 per cent of the labor cost and is believed to average much more than is indicated by this single factor. Construction accidents are largely caused by carelessness of workmen or lack of ordinary safeguards and it is believed that it is entirely practicable to reduce the loss sustained through them by from 75 to 80 per cent with less than five years of honest effort, which would probably save 12,000,000 days' time per year.

Acceptable Risks for Surety Companies

An article in the July number of the bulletin of the Associated General Contractors of America discusses the viewpoint of the bonding companies for construction work, and concludes that they discourage too low or too high bids and, very rationally, prefer that the contractor for whom they are sureties should know his business, make reasonable bids, and have sufficient equipment together with sound finances and integrity.

The premium charge upon the bond of the contractor for the surety company's guarantee of his finances and skill is just as properly an item of the cost of the work as the labor, materials or supplies, and from it the surety company does not make a net profit to exceed 1 per cent, although it may lose heavily.

Their usual criterion is that the applicant shall have cash on hand equal to 10 or 15 per cent of the amount of the work undertaken, where estimates of 85 or 90 per cent of work done and materials covered are paid monthly or semi-monthly.

The contractor should have other assets, such as unpaid balances for work performed, accounts receivable and other items that may serve as collateral for bank loans; should have real estate and sufficient good equipment; should have experience in successfully handling similar work; and should not be obligated for too many jobs for his capital.

PUBLIC WORKS

Published Weekly
by
Public Works Journal Corporation
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba. $3.00 year
All other countries .... $4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

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Activated Sludge Process to Date

An excellently comprehensive and clear statement of what is now known concerning the activated sludge process, as to its principles of action, the results obtained and difficulties yet to be overcome, is given in the paper by Harrison P. Eddy, begun last week and concluded in the present issue. Much of interest and valuable information can be found in this article by any interested in the subject, with the possible exception of the half dozen or so who are already familiar with every feature and detail of the investigations made and results obtained in connection with this method of sewage treatment both in this country and abroad.

Considering the number of years that activated sludge has been under investigation and the interest taken in it, the number of plants in active operation is exceedingly small, and many may wonder why this should be the case, remembering the rapidity with which septic tanks were built all over the country fifteen or twenty years ago, when that was the leading treatment method. The explanation probably lies in the cost of both constructing and operating the activated sludge plants, with the difficulty and uncertainty connected with the handling and utilization of the sludge as an additional cause.

During a discussion of the subject at the latest convention of the American Society for Municipal Improvements, some interesting points were brought out by the sanitary engineers present. In the matter of cost, Langdon Pearse reported that a comparison of the cost of sprinkling filters and of an activated sludge plant for a city of 50,000 population in Illinois, gave the cost of a sprinkling filter as $630,000 and of an activated sludge plant as $540,000; but the operation of the former would cost only $21,000 a year while that of the activated sludge plant would cost $81,000, or, with certain allowances for economies and sale of sludge, possibly $56,000; exclusive of interest in each case. These figures were based on a cost of two cents per k. w. h. for power. Mr. Pearse concluded that "there is no chance, with our present conditions, on this size of plant, to bring the cost of activated sludge down to a par with tanks and sprinkling filters on a total annual charge."

T. Chalkley Hatton stated that they estimated for Milwaukee that the cost of operation would be $2 per million gallons more for activated sludge than for sprinkling filter, after crediting the former with $18 as the estimated value of the activated sludge produced, this including interest, sinking fund and other overhead charges.

As to sludge difficulty, Mr. Pearse said that this was not now so much a matter of machinery but of conditioning the sludge so that the water can be extracted readily. In Houston, however, after having been pressed, the sludge is a very sticky substance which cannot be handled by conveyors as it gums them up and will not drop off of them at the end of the conveyor run.

Inevitable Requirements

A serious joint consideration of the articles in this issue on the construction industry and on improving building construction must lead not only to overwhelming conviction of the tremendous present and future construction opportunities that cry aloud to be accepted and developed for almost unlimited wealth and prosperity, but also to a better realization of the sinister influences that, stimulated by profiteering, politics, and war emergency, have offset favorable economic, industrial, and financial conditions so much that a vast amount of the possibilities are still unrealized and in danger of depreciation.

Many of the brilliant prospects of 1920 which were fully justified have been retarded and some have been seriously injured by failure to resume sound conditions that were indispensible to the full prosperity of 1921. In order to provide for the splendid opportunities of 1922 that offer almost incredible rewards for enterprise and capital it is necessary to effect a nation-wide revision of bad practices and remove the principal difficulties that have this year needlessly blocked adequate resumption of construction. These have been recognized, admitted or excused accordingly to the intelligence, fairness or courage of the individual. The essential factors, previously more or less well known, have now been impartially weighed, compared, and analyzed and it is established that we have well within our reach the principal essentials for rapid and enduring construction prosperity.

The vital elements include regularity and continuity of employment; increased and improved mechanical equipment; fair labor regulation; labor union reform; more accurate and rational construction management; abolition of wasteful labor regulation; increase of apprenticeship; increased working hours; reduction of labor turnover; and the prevention of waste and loss of human life due to preventible accidents.

Let construction associations and individuals, financial and industrial interests, and representatives of labor vigorously maintain an honest and sincere effort to establish these improvements and there will be no delay in the flood tide of engineering construction in this country.

Lights and Shadows of the Activated Sludge Process*

By Harrison P. Eddy

Preliminary fine screening. Removing floc. Disposing of sludge. Possible improvement.

PREPARATORY TREATMENT BY FINE SCREENING

A very important advance has been made by demonstrating that it is possible to remove sufficient of the heavy and coarse solids of strong municipal sewage, by means of grit chambers and fine screens, to prevent the accumulation of deposits upon diffuser plates which are supplied with air at the rate of 1 cubic foot per minute per square foot of plate area. This assures the successful operation of aeration tanks which prior to this demonstration was open to some question in cities where there is a very large proportion of heavy settling solids.

There is opportunity for further investigation to determine whether the quantity of air required can be materially further decreased by screening finer than that which has already been employed. This would appear to be a promising field for study.

In some cases—particularly where industrial wastes, such as those from tanneries and packing houses are present—the advisability of sedimentation as a means of preparing the wastes for aeration, is worthy of careful consideration. Some such wastes contain very large quantities of coarse and heavy suspended matter, and it is possible, and in some cases probable, that preparatory sedimentation may result in a substantial saving in air and may possibly also be so important as to make the process practical where without such preparatory treatment it might prove impractical.

SEDIMENTATION—REMOVING FLOC

Obviously it is necessary to remove the floc in order to produce a satisfactory effluent—it would be folly after having gone to the expense necessary to form the floc, to allow it to escape with the effluent and thus nullify the work done in the first stage of the process.

The character of the floc—whether of light weight and voluminous due to under-aeration or low temperature, or heavy and compact as a result of thorough aeration under favorable conditions—has an important, if not vital, effect upon the sedimentation process. If the floc is light and voluminous it settles less rapidly, is more easily carried over the weirs in the affluent, and, most important of all, it fails to consolidate and become compact as it accumulates in the tank. Generally a well-activated sludge settles very rapidly and forms a relatively compact or dense sludge.

A good floc may form a sludge containing as much as 3 per cent solids and readily form one of 2 per cent, while a light, fluffy floc will often produce a sludge of 1 per cent and sometimes of only ½ per cent solids. The difference between sludges from under-aerated and well-aerated sewage is readily appreciated when the volumes of sludge to be handled are considered. The volumes which commonly occur, based upon a uniform quantity of suspended solids, are given in Table 1.

Table 1—Relation of Volume of Sludge to Proportion of Total Solids

(Original Sludge 2 per cent total solids; dissolved solids 800 p. p. m.)

Water in Sludge,	Total Solids in Sludge,	Suspended Solids in Sludge,	Relative Vol. of Sludges of diffr't Densities,	Vol. of Sludge to be returned to afford Uniform Quantity of Suspended Solids, Gal.	Vol. of Sludge to be Wasted Gal. p. M. G.
%	%	%	%	p. M. G. Sewage	Sewage
99.5	0.5	0.42	100	909,000	68,200
99.0	1.0	0.92	46	418,000	31,400
98.5	1.5	1.42	30	273,000	20,500
98.0	2.0	1.92	22	200,000	15,000
97.5	2.5	2.42	17	155,000	11,600
97.0	3.0	2.92	14	127,000	9,500

The volumes of sludge to be returned and wasted, as indicated by Table 1, are based upon the assumption that these volumes will be equivalent to 20 per cent and 1.5 per cent, respectively, of the sewage treated when the sludge contains 2 per cent total solids.

The importance of providing a relatively dense sludge is obvious from these data. If 20 per cent of sludge containing 2 per cent solids be required for the successful treatment of the sewage in the aeration tanks, and if for any reason the density of the sludge is suddenly changed to 0.5 per cent solids, the volume which must be pumped into the sewage to furnish the same quantity of suspended solids will be increased from 200,000 to 900,000 gallons per million gallons of sewage to be treated, and all portions of the plant devoted to aeration, sedimentation and sludge return, must have capacities for this greater quantity, if the density be permitted to fall to this extent. Similarly, were it assumed that sludge having 0.5 per cent solids can be dewatered with equal facility to that having 2 per cent solids, equipment must be provided for handling 68,200 gallons of thin sludge per million gallons of sewage, instead of 15,000 gallons of normal sludge containing 2.0 per cent solids. Furthermore, the indications are that thin under-aerated sludge is not as easily dewatered as normal well-aerated sludge. From the foregoing discussion it is clear that the success of the activated sludge process depends in large measure upon the production of a good floc and its efficient removal. So important is this phase of the treatment that it may well prove the controlling feature, and it may therefore be necessary to operate the plant primarily for the production of a good floc providing such quantity of air and period of aeration as may be required for this purpose even though the quality of effluent produced be better than necessary.

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*Continued from page 115. Paper before the Western Society of Engineers.

In proportioning sedimentation tanks, four requirements should be kept in mind:

1. Opportunity must be afforded between the point of entrance and the point of exit for the floc to settle sufficiently to prevent its being carried out of the tank with the effluent.
2. The rate of sludge withdrawal must be such as to retard the travel of the floc enough to permit it to consolidate and form a relatively dense sludge.
3. There must be provision for drawing the sludge with sufficient rapidity to prevent its being delayed in passage to such an extent that it will undergo septic action which will render it less suitable for the treatment of the incoming sewage and particularly unfavorable for dewatering by methods now in use.
4. There must be sufficient tank capacity to provide space for the accumulation of the floc, which varies greatly from time to time during the day, according to the variation in the strength of sewage, as well as to other conditions, and also for the accumulation of the abnormally voluminous floc during brief periods of cold weather or under-aeration, neither of which can be entirely counteracted or avoided.

As stated by Mr. Hatton, the proposed Milwaukee sedimentation tanks have been designed to receive aeration tank liquor at a rate sufficient to produce 1,600 gallons of effluent per 24 hours per square foot of gross internal tank area at times of maximum flow. The average rate of flow in dry weather will be about 850 gallons per square foot. In the demonstration plant the sedimentation tanks have received as much as 2,000 gallons of aeration tank liquor for substantial periods of time during which the effluent was satisfactory. The more conservative allowance for design was adopted in order to provide for contingencies, such as a light fluffy sludge and changes in volume and quality of sewage. Some of these conditions may be coincident and last for a substantial length of time, as for example, in the spring when snow is melting the flow of sewage is high and its temperature is low.

Tests indicate that the floc from municipal sewage and from some industrial wastes may be concentrated readily to a sludge containing 2 per cent, and under favorable conditions possibly as high as 3 per cent solids. To secure a greater concentration requires storage for so long a time that there is danger of septic action with its attendant evils. The safe limit of such storage may perhaps be taken at 6 hours, until such time as more data bearing upon this specific point become available.

SLUDGE LAGOONS

One of the most interesting developments is the disposal of sludge by pumping it into lagoons at Houston, Texas.

At the South Side plant, which was started in August, 1918, all of the sludge produced up to the time this plant was visited by the writer in July, 1919, had been pumped into one lagoon which was about 300 feet long, 100 feet wide and 7 feet deep, with side slopes of about 1 on 1½. At that time there was no offensive odor from this lagoon. There was, however, the characteristic odor of algae, which appeared to be growing in considerable quantities. No water had been drawn off from the lagoon, the supernatant water was clear, many gas bubbles were being given off, and some sludge was being carried to the surface by the gas bubbles, but immediately subsided. There was no floating sludge.

At the North Side plant, where the sludge had been run into three lagoons, conditions were substantially the same.

SLUDGE DEWATERING

Perhaps the darkest spot in the entire process of activated sludge treatment is that of sludge dewatering, which has been studied at the Packingtown, Houston and Worcester plants, and particularly by investigations covering a period of several years at the Milwaukee testing station. Notwithstanding all of the investigational work thus far done, this problem cannot be said to have been satisfactorily solved at the present time.

It has been repeatedly demonstrated that well-activated sludge can be dewatered more advantageously than an under-aerated or a stale septic sludge. It is accordingly necessary to so operate the plant, insofar as practicable, to avoid under-aeration, prolonged storage which tends to cause septic action, and probably also over-aeration which tends to resolve the floc into its colloidal condition. It is probable that the plant must be operated with a view to producing the sludge in a condition to be most readily dewatered, although there is promise that a poor sludge can be conditioned so as to be successfully dewatered.

Table 2.—Nominal Volume of Sludge Produced by Different Processes of Sewage Treatment

Treatment Process	Nominal Vol. of Sludge, gal. per mil. gal. of sewage treated	Proportion of Solids in Sludge	Spec. gravity of Sludge	Wt. of dry solids in sludge, lb. p. mil. gal. of sewage treated
Activated Sludge	10,000	2.00	1.005	1,675
Chemical Precipitation	5,000	7.50	1.040	3,250
Sedimentation	2,500	5.00	1.020	1,060
Septic Tank	500	5.00	1.040	220
Imhoff Tank	500	15.00	1.070	670
Trickling Filter—Humus Tank	500	7.50	1.025	320

One phase of the magnitude of the sludge disposal problem may be readily appreciated by a comparison of the nominal volumes of sludge produced by the several processes of sewage treatment now in use, Table 2.

While it is recognized that the volume of sludge produced by any of these processes will vary materially according to local conditions, and particularly to the proportion of solid matter removed from the sewage, the activated sludge process, under all conditions, is likely to produce a very much greater volume of sludge than any other process.

For the dewatering of activated sludge consideration may be given to the use of four types of machines—the plate or standard filter press, the squeeze press commonly known as the Worthington or Berrigan press, the Schaefer-ter-Meer centrifuge and the Besco-ter-Meer* centrifuge.

The plate press consists of a large number of thin round or square cast iron plates, concave on both sides, supported in vertical position upon two horizontal side rods. The plates are covered on both sides with cotton duck and when forced tightly together in closed position, form thin chambers into which the sludge is pumped under a pressure of about 100 pounds per square inch. The water of the sludge is forced through the duck and escapes by means of corrugations on the faces of the plates and holes cored in them. The solids are retained upon the cloth and gradually form a very compact cake. After the cake has begun to form in this manner, the water must pass through it as well as through the cloth in order to escape. When the sludge is fresh, well-activated and in most favorable physical and chemical condition, a cake about 1 inch thick may be formed in about two hours. Under such conditions the cake is easily separated from the cloth, leaving it relatively clean for the next pressing. Under other conditions the sludge has entirely different characteristics and may require 4 or 5 hours for the formation of a cake and even then the cake may be so moist that it cannot be removed without leaving the cloth smeared with slimy sludge and in poor condition for further use, if indeed it can be so used without previous washing. The sludge may be in such condition that its dewatering by this method is impracticable.

The squeeze press is of entirely different construction and operates upon a different principle. In this case a number of bags, open at the bottom, are held in position by supports at the top. Between each pair of bags is a corrugated drainage rack, also supported at the top. Preparatory to filling, the bottoms of the bags are forced tightly together to prevent the escape of liquid sludge, which is then allowed to flow by gravity or under slight pressure into the bags, through small flexible tubes attached to a sludge pipe header at the top. During the filling, which is done slowly, a portion of the water escapes through the cloth. When the bags have become filled, the sludge supply is shut off and pressure is applied to all the bags by means of two end platens which are forced toward each other under considerable pressure, thus squeezing the bags and forcing the water out through the cloth, whence it escapes through the vertical corrugations in the drainage racks. In this way the water is squeezed out of the sludge in a manner similar to that employed in the home-made "jelly bag," leaving a rather homogeneous mass of moist solids. There is no formation of compact cake on the inner surface of the cloth, as in the case of the plate press. When the sludge is in favorable condition the pressing may be completed in approximately 4 hours. Dewatering by this type of press does not appear to be so greatly affected by unfavorable condition of the sludge as in the case of the plate press, although the time of pressing is materially increased and the cake usually contains more moisture.

In the original Schaefer-ter-Meer centrifuge the sludge is admitted to a revolving drum which is closed at the top, and is subdivided into radial compartments each of which has a perforated plate or screen through which the water is thrown by centrifugal force. The solids form a cake on the perforated wall of the chamber, in much the same manner as the cake is gradually formed in the plate press. The water must pass through this cake in order to escape.

The Besco-ter-Meer centrifuge is similar in general mechanical construction to its predecessor, the Schaefer-ter-Meer, except that the drum is open at the top and is not subdivided into compartments. There are no screens or perforations. In this case the solids are thrown, by centrifugal force, against the wall of the drum, where they gradually build up a cake, leaving the water in the center of the drum to be thrown upward and over the top by centrifugal force. In this type of centrifuge it is obvious that it is not necessary to force the water through the cake, as in the case of the Schaefer-ter-Meer centrifuge or the plate press.

Experiments with Besco-ter-Meer centrifuge show that it is possible to secure a cake of from 80 per cent to 85 per cent moisture. However, the centrifuge effluent contains a very large proportion of the original suspended solids—from 80 per cent to 50 per cent. There seems to be a segregation of solids, the larger and heavier particles being formed into cake and the lighter and finer matter remaining in the effluent.

It is extremely difficult to remove this residual matter by subsequent centrifuging either by itself or when mixed with fresh normal sludge.

ACIDIFICATION OF SLUDGE

Activated sludge is normally slightly alkaline and it has been found that its natural slimy characteristics can be counteracted in a measure by acidification. The quantity of acid required will vary according to conditions, but in general, if sulphuric acid is used it may be taken at about 0.12 per cent by volume of the sludge to be dewatered. If it be assumed that the waste sludge will be equivalent to 1.5 per cent of the sewage treated, or 15,000 gallons per million gallons of sewage, the quantity of sulphuric acid required, upon this basis will be about 1.2 gallons per thousand gallons of sludge, equivalent to 270 pounds of commercial sulphuric acid per million gallons of sewage. At 1 cent per pound, the cost of acid will be about $2.70 per million gallons of sewage treated.

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*A modification of the Schaefer-ter-Meer centrifuge deriving its modication in name from the Barth Engineering and Sanitation Company, American agents.

The cost of acid may be offset in part, or perhaps wholly, by an increase in ammonia content of the dried sludge. This is because of the neutralization of the alkalis with acid, after which heating in the drier does not drive off the nitrogen in the form of ammonia, as is the case when unstable nitrogeneous compounds are heated in the presence of alkalis. The gain in ammonia due to acidification, while varying in different sludges, may be taken at about 12 per cent.

There is likely to be another apparent increase in the ammonia content of the dried sludge, due to the effect of pressing, by which a substantial proportion of the solids in the sludge pass away in the form of press liquor. The proportion of nitrogen in these solids is somewhat lower than that in the suspended matter, due to the large proportion of colloids high in nitrogen in the latter. The removal of the dissolved solids, therefore, results in an increase in the proportion of nitrogen in the dry solids of the sludge cake over that in the dry solids of the original liquid sludge.

The effect of the apparent increases due to acidification and to pressing, when applied to the dried sludge containing 10 per cent moisture and computing the value of the sludge at $4 per unit, are shown in Table 3.

Table 3.—Estimate of Quantity and Price of Fertilizer from Strong Municipal Sewage*

Volume of sludge, per m. g. sewage		15,000 gal.
Proportion of dry solids		2%
Weight of dry solids per m. g. sewage		2,500 lb.
Wt. fertilizer with 10% moisture	2,780 lb. equals	1.39 tons
Proportion of ammonia in dried unacidified sludge containing 10% moisture (6% ammonia on dry basis)		5.4%
Increase in ammonia, due to acidification		12.0%
Ammonia in dried acidified sludge		6.05%
Increase in ammonia due to pressing		9.0%
Ammonia in dried acidified press cake		6.59%
Price per unit of ammonia	$4.00	
Value per mil. gal. of sewage—		
Fertilizer—nominal—unacidified, unpressed, dried	$30.02	
Fertilizer — nominal — acidified, unpressed, dried	33.64	
Difference, due to acidification		$3.62
Fertilizer—acidified, pressed, dried	36.64	
Difference, due to pressing		3.00

*No allowance for losses.

It therefore appears that there is a theoretical increase in value of $3.62 per million gallons of sewage, due to acidification. If the price be taken at $2 instead of $4, per unit of ammonia, the difference would be but $1.80—hardly enough to pay for the acid.

Present indications are that the return from the sale of fertilizer will partially, and perhaps wholly, offset the cost of dewatering and drying the sludge, but that there will probably be no surplus applicable to the operation of other features of the plant.

SLUDGE DRYING

Sludge drying is similar to the drying of many other materials, which has been thoroughly developed in the arts. There does not seem to be any problem peculiar to the drying of sludge. There is, of course, the danger of burning the sludge, of creating objectionable odors, and of the escape of considerable dust. Care in manipulating driers designed for the purpose should reduce to a minimum the liability of burning or scorching the sludge. If the gases from the driers are passed through suitable dust chambers and are thoroughly washed, dust can be entirely eliminated and there does not seem to be danger of dissemination of disagreeable odors. It will, however, be advisable to discharge the washed gases through a relatively high stack.

MANAGEMENT

One of the most serious inherent dangers in the application of this process lies in its management. The process is complicated by a large number of steps, each more or less dependent upon the preceding one. Skilful, conscientious, technical management will be required to keep all features operating to best advantage, with the marked variations in volume, character and temperature of the sewage, and the multitude of ordinary operating difficulties.

It remains to be demonstrated whether such a process can be successfully operated as a commercial project under municipal conditions generally prevailing in the United States. To assure success it will be necessary to enter the market and dispose of the commodity produced as advantageously as the laws of supply and demand will permit. Prices are subject to radical fluctuations, but the costs under municipal control will probably not fluctuate in a commensurate manner. The one thing which is assured from the outset is a very substantial cost, but it may be hoped that enough revenue will be derived to so reduce operating expenses as to prevent them from becoming an unreasonable burden.

TWO IMPORTANT ADVANTAGES

There are two very important advantages of the activated sludge process—the production of a well-purified effluent of attractive appearance, and the complete disposal of the sludge. These advantages are well worth striving for. At present it would seem that this process is particularly worthy of consideration where such an effluent is desired, and where power may be obtained at moderate cost. Obviously it is an advantage for such a plant to be situated in a district where large quantities of fertilizers are used, thus avoiding the necessity of shipping the sludge long distances.

OPPORTUNITIES FOR IMPROVEMENT IN PROCESS

There appear to be two features which give promise of great improvement, on further investigation—the aeration and agitation of the sewage, and the dewatering of the sludge. It may be that the former can be accomplished by some sort of mechanical agitation accompanied by the use of a small quantity of air to maintain aerobic conditions. This would seem to be more easily applied to a small plant than to a very large one like that at Milwaukee, although if the saving in operating expense is sufficient, the size of the plant would probably not offer an insurmountable obstacle to the adoption of such a method.

At present the hope of improving the method of dewatering appears to lie in the direction of conditioning the sludge rather than improvement of mechanical appliances, although the latter subject should by no means be neglected.

Recent Legal Decisions

MOTIVES OF MUNICIPAL OFFICERS AND VOTERS CANNOT BE JUDICIALLY INVESTIGATED IN INJUNCTION SUIT

The Supreme Court of the United States holds, Detroit United Ry. v. City of Detroit, 41 Sup. Ct. 285, that the motives of the officials of a municipal corporation and of the electors in adopting an ordinance to construct a municipal street railway after the expiration of the franchise of the existing street railway company, are not proper subjects of judicial inquiry in a suit for injunction by the street railway company, so long as the means adopted for submission of the question to the people conformed to the requirements of the law.

PARTY TO ILLEGAL MONOPOLY CANNOT, WHEN OVERREACHED, RECOVER STATUTORY PENALTY

In an action to recover a statutory penalty provided by Indiana Burns' Ann. St., 1914, par 3872, it appeared that the specifications for pavements were drawn so as to require the use of a road binder of which the defendant had a monopoly, and the plaintiff bid on the work on those specifications on the defendant's assurance that it would furnish the binder at six cents a gallon; but it "boosted" the price on him. The Indiana Appellate Court held, Moore v. Barrett Co., 130 N. E. 649, that the plaintiff contractor could not recover the statutory penalty, notwithstanding that the arrangement between the defendant and the board of county commissioners and others was in furtherance of a monopoly, and so criminal under sections 3866 and 3868 of the Indiana statutes. The plaintiff knew all the time that the whole transaction was illegal and void, and he could have repudiated the entire matter, had he chosen to do so. His purchases of the material were, under the facts alleged, purely voluntary.

RATE OF COMPENSATION AS DEPENDENT ON TIME OF COMPLETION OF WORK

A drainage contract provided that if the work be performed prior to January 1, 1918, the contractor should receive the sum of 11¼ cents per yard, but if not performed prior to that date he should receive the sum of 9¾ cents per yard. The work was not completed by January 1, nor for some time thereafter. The Minnesota Supreme Court holds, Frederick v. Redwood County, 182 N. W. 514, that the plaintiff was entitled to the lower rate of compensation only. The reduction from 11¼ to 9¾ for the failure to complete the work within the stipulated time is not to be construed as a penalty for a breach of the contract and is therefore valid. The allowance of the higher rate was evidently provided for as an inducement to extra exertions in the performance of the contract; the lower rate being intended as the agreed compensation.

CONTROVERSY OVER CONTRACT HELD SUFFICIENT CONSIDERATION FOR NEW CONTRACT

The Iowa Supreme Court holds, Horton Tp. v. Drainage Dist. No. 26, 182 N. W. 395, that a controversy between a drainage contractor who had not completed the parts of the work which he had commenced, and the county board of supervisors, as to who was in default, he not having been paid in money as provided by the contract, nor given an extension claimed, on account of unavoidable scarcity of labor, and the board having prematurely served notice of cancellation of the contract, was sufficient to constitute a consideration for a compromise contract by which he was to finish the work begun and be released from the rest.

ORDINANCE AUTHORIZING LAYING OF TRACKS AND REQUIRING PAVING IMPOSES OBLIGATION ON ACCEPTANCE

In an action by a municipality against a street railway company for payment of the expenses of paving between the rails and tracks of the company, and three feet on each side thereof, the New Jersey Court of Errors and Appeals holds, Borough of Merchantville v. Camden & S. Ry. Co., 113 Atl. 136, that a railway company, having accepted an ordinance granting permission to lay its tracks on a public highway in its entirety, must accept the burdens. It cannot accept the benefits and reject the burdens. This is so, even when the work done by the municipality, from which the obligation arose, was ultra vires. A railway company cannot stand by and see public work done, for which it may be liable, under a resolution, and then raise the question of the propriety of the procedure collaterally, viz., that the work should have been done under an ordinance, and not by resolution.

DEPARTURE FROM PAVING SPECIFICATIONS RESULTING IN LACK OF SUBSTANTIAL PERFORMANCE BARS RECOVERY

Where a paving contractor's departures from the specifications resulted in pavements which would "disintegrate and wear out many years before they should had they been built in accordance with the specifications," there is no substantial compliance with the contract. That being so, the Pennsylvania Supreme Court holds, Wright v. Barber, 113 Atl. 200, that the contractor could not recover even for the work done, for any other conclusion "would tend to demoralize the whole country." And where it was found that it would cost more than the balance of the contract price to put the work in the condition provided by the contracts, a taxpayers' bill to enjoin further payments under the contracts was sustained.

AGREEMENT WITH MAYOR DOES NOT BIND CONTRACTORS TO SUBMIT TO ARBITRATION

An agreement between the mayor of a city and contractors with the city that the council is to decide what amount, if any, is still due the contractors, is not sufficient to amount to a submission to arbitration, so as to prevent suit by the contractors for the balance claimed.—Johnson v. City of Prineville. Oregon Supreme Court, 196 Pac. 817.

NEWS OF THE SOCIETIES

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference. Hotel La Salle, Chicago, Ill.

Aug. 23-25—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS Annual meeting. Detroit, Mich. Secretary, Emmet P. Griffin, Superintendent of Park, East St. Louis. Ill.

Aug. 30-Sept. 1—MICHIGAN STATE GOOD ROADS ASSOCIATION. Annual meeting. Flint. Mich.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventth annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 5-7—SOCIETY OF INDUSTRIAL ENGINEERS. National convention. Springfield, Mass.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore. Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building. Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

AMERICAN ENGINEERING COUNCIL

On June 3, the membership of the American Engineering Council included twenty-seven member organizations, two other societies have since made application for membership, and other engineering organizations have the question of joining the Federation under serious consideration.

Service has been accepted by 58 men on the following nine committees: Military Affairs, Payment for Estimating, National Board of Jurisdictional Awards in Building Industry, Classification and Compensation of Engineers, Cooperation with American Institute of Architects, Types of Government Contracts, Patents Committee, New York State Government Reorganization, Licensing and Registration of Engineers.

The most important committee work of council at the present time is the study of Elimination of Waste in Industry. It is contemplated that the report of the committee will be ready for general distribution early in September. Special committees recently appointed are a Foreign Relations Committee, a Committee on the Employment Service, and American Engineering Congress Committee. The standing Committee on Procedure and the Committee on Public Affairs are constantly being called upon for the guidance of the work of Council.

Under the direction of the latter committees council is actively at work in advancing the plans for a National Department for Public Works, to help improve the status of public health engineers, to obtain equitable engineering research legislation, co-operating with the American Engineering Standards Committee, working for the appointment of engineers to engineering positions in the federal government, support for topographic mapping program, etc. A special employment committee has under consideration a definite plan for improvement and extension of the service, whereby it is contemplated that special arrangements will be made to care for the interest of constituents of member organizations in the present employment crisis and that general plans will be adopted and put into operation whereby this service will be of the greatest possible direct value to every member organization.

The American Engineering Congress Committee is at work planning for the Engineering Congress which is to be held in connection with the annual meeting of A. E. C.

PERSONALS

King, Lt.-Col. Frank B., has been placed in charge of the water and sewer extensions at Duncan, Okla., for V. V. Long & Co., Oklahoma City, Okla.

Moorefield. Charles H., has been appointed state highway engineer of South Carolina.

Hays, James P., has been appointed general superintendent for the Austin Co., Cleveland, Ohio, on the construction of a $250,000 soldiers' memorial auditorium at Mount Union College, Alliance, Ohio.

Roe, Dr. Joseph W., has been appointed professor of industrial engineering of the New York University.

Hewes, Charles E., has been appointed city manager of Long Beach, Cal.

Hickok, Major Clifton E., has been appointed city manager of Alameda, Cal.

Wehrung, J. Powell, has been appointed county engineer of Runnels county, Texas.

Limerick, R. C., has been appointed state highway engineer of the Arkansas Highway Commission.

Brock, William F., has been appointed highway engineer with the United States Bureau of Public Roads at Jackson, Miss.

Shaw, Arthur M., will supervise the design and construction of a complete sanitary sewer system at San Pedro Sula, Honduras, C. A.

Leonard, Offie, has resigned his position as office engineer of Travis county, Texas.

Buck, C. D., has been appointed assistant state highway engineer of Delaware.

Welborn, W. C., has become city engineer of Paris, Texas.

Woodworth, Dr. Philip, has been appointed president of Rose Polytechnic Institute, Terre Haute, Ind.

Davis, E. W., will act as city engineer of Longview, Texas.

Hengst, M. C., has been appointed highway engineer of Barry county, Mich.

Howe, Harry N., has been appointed commissioner of streets of Memphis Tenn.

McCaulies, L. C., has resigned as county engineer of Callahan county, Texas.

Laird, L. E., has been made state highway superintendent of Wyoming.

King, W. J., has resigned as county engineer of Labette county, Kansas.

Brewer, T. M., has been appointed city engineer of Viroqua, Wis.

Chambers, John, has been appointed chief engineer and superintendent of the Louisville Water Co., Louisville, Ky.

Higgins, Lafayette, has resigned as state sanitary engineer of the Iowa State Board of Health.

Manley, R. G., has been appointed superintendent of streets and city engineer of Upland, Cal.

Reid, Joseph Y. L., has been appointed superintendent of the filtration plant at Trenton, N. J.

Mylchreest, Joseph W., has been appointed city engineer of Middletown Conn.

Kringel, August E., has been appointed city engineer of Green Bay, Wis.

Rogers, C. J., has been appointed county engineer of Jefferson county, Ala.

INDUSTRIAL NOTES

SULLIVAN MACHINERY CO.'S NEW OFFICE

The Cleveland office of the Sullivan Machinery Company was moved on July 1 from 810 Park building to Room 824, Kirby building. Ralph T. Stone is manager at Cleveland.

The Sullivan Machinery Company announces the establishment of a supply depot and service station for coal mining machinery supplies and repair parts at Seventh avenue and 13th street, Terre Haute Ind., with H. T. Wiley, formerly of the engineering department at the Claremont, N. H., works in immediate charge.

William H. Okum has been appointed vice-president and works engineer of the Superior Wood Heel Co., Brooklyn, N. Y.

The Badger Concrete Mixer Co., Milwaukee and Watertown, Wis., will erect a factory at Winthrop for the manufacture of Badger concrete mixers and McVicker tie plates for the Railway Safety Tie Co.

Horace M. Bringhurst is sales engineer in charge of the steel lumber department of the General Iron Works Co., Cincinnati, Ohio.

The Pacific Coast Concrete Co. has its new offices at 827-29 Pacific Mutual building, Sixth and Grand avenues, Los Angeles, Cal.

J. F. Hall-Martin Co. have their offices now at 229 Douglas building, Los Angeles, Cal.

The Red River Valley Concrete Products Company has a new factory in Crookston, Minn.

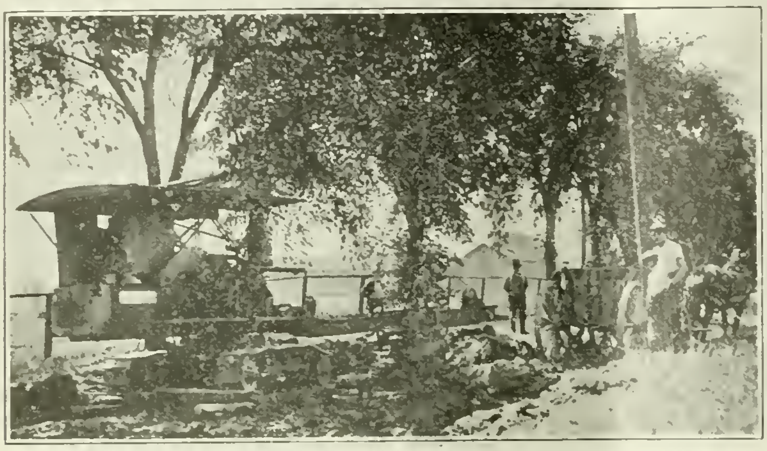
Hartley Rowe has been appointed manager of the Boston office of the Lockwood, Green & Co.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

NEW P & H SKIMMER COOP

A new skimmer scoop has been put on the market by the Pawling & Harnischfeger Co., of Milwaukee, to be used with either of the 205 or 206 P & H excavator cranes. This may be attached in place of the standard boom in a manner similar to the shovel attachment, which was brought out early this spring. The development of this skimmer scoop broadens the field of application of P & H excavator cranes, allowing the contractor to keep down his investment in machinery.



BOOM HORIZONTAL; BUCKET EXCAVATING SURFACE CUT

The illustration, Fig. 1, shows the skimmer scoop on the full corduroy 206 machine working on a grading job on Hawley road, Milwaukee county, Wisconsin. Here the bucket is shown, in one view, at the end of the travel along the boom while the other view shows the boom elevated and the load being dumped into a wagon.

BOOM ELEVATED AND REVOLVED TO DISCHARGE CONTENTS OF BUCKET INTO WAGON

That this type of road-making machine is of real value is shown by the record of Wm. Datka, Milwaukee, contractor for the Hawley road grading job, who effected a saving of $83.44 per day and executed the work in shorter time by the use of the machine.

General Data—Number of days on job, 8; total cubic yards excavated, 2,578 cubic yards; total hours worked, 79 hours; excavated per hour, 32.6 cubic yards; number of days saved in using machine in place of wheelers and plows, 2 days.

Classified operating costs·

Total cost per day operating with skimmer scoop, including interest and depreciation (assuming 5 years life of machine)	$ 91.25
Number of days operating	8
Total cost	730.00
Total cost per day with wheelers, scoops and plows	130.00
Number of days (estimated)	10¾
Total cost	1,397.50
Total cost with skimmer scoop	730.00
Difference	$667.50

MOTOR TRUCK TRAILERS

Motor truck trailers manufactured by the Detroit Trailer Co., are described in a 32-page catalog that profusely illustrates 4-wheel models B and D, reversible and non-reversible 4-wheel drop frame trailers, trailers of 1½ to 15 tons capacity, Model C trailers for light work and semi-trailers of from 3 to 15 tons capacity. Among the distinctive features of the trailers are the bell shape draw head with a positive cam latch which eliminates looseness, assures alignment and provides instantaneous connection with the truck.

The steering arm is attached to the axle and compels the trailer to follow the line of the truck. The wheels are kept parallel by an independent tie-rod connecting the drag link and the knuckle steering arms. When the draw bar is swung to the center of the frame the wheels are automatically locked parallel to the frame. The springs are double shackled.

The model D, drop frame trailer can be hauled either by horses or motor trucks and is efficient for handling garbage, ashes and street cleaning where the material is picked up by horses and the long distance hauling is done with motor trucks or tractors. More than two-thirds of the loading can be done with the body tilted to a loading height of 48 inches or less. It is made in six sizes of 2 to 5 yards, water level capacity and may be fitted with any special bodies ordered.

Various standard types of bodies of different capacities are made to dump at the side or end. Trailers made in five sizes with capacities of 1 to 8 tons, are designed for a swivel bolster, a single stationary bolster, double bunkers or bolsters as required. For hauling very long material a bolster can be provided to go on the truck patform and let one end of the load rest on the truck bolster and the other end rest on the trailer.

SEGMENT SEWER BLOCKS, SEWER PIPES AND FITTINGS

Segment sewer blocks manufactured by the Robinson Clay Product Co., are distributed from offices and yards in New York, Chicago, Boston, Buffalo, Syracuse and Toronto. The segment blocks, pipes and other fittings of this company are made of vitrified Ohio shale and clay, highly glazed and impervious to water and chemical action. They are of ample strength and have well bonded scarified joints filled with cement mortar. An especial advantage is that the first line of blocks laid in the invert of the sewer automatically produces a perfect subdrain.

Standard segment blocks are provided for diameters of 30 to 108 inches with respective thicknesses of 4¾ to 10½ inches and corresponding weights of 250 to 1930 pounds per lin. foot.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

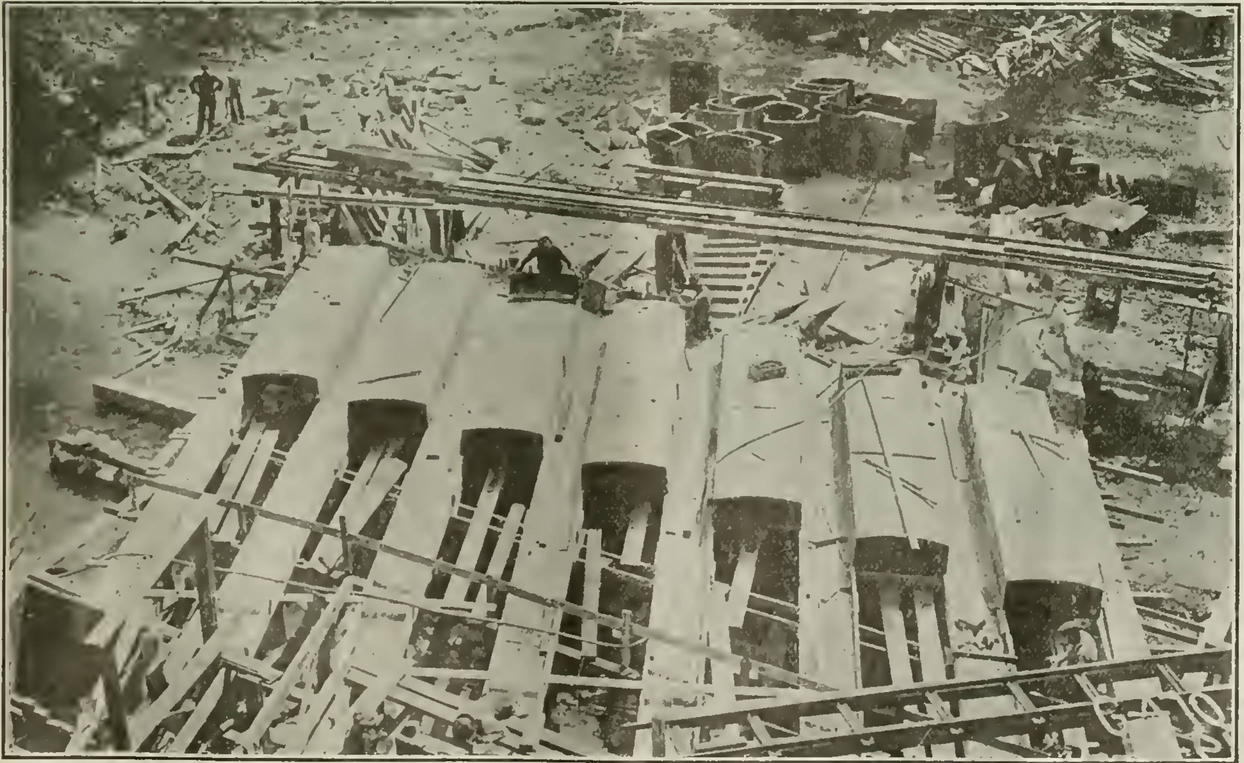
Vol. 51 AUGUST 20, 1921 No. 8

Slab and Beam Bridge With Stone Arch Face

By James Owen*

In the Bronx Parkway stone arches were desirable for short-span bridges, but were rendered difficult and expensive by the soft foundation. To meet this condition the engineers designed a concrete slab and beam bridge with a stone arch face giving the appearance of a stone bridge.

A considerable number of small bridges spanning the Bronx river form an important item of development work on the Bronx River Parkway Reservation, which extends from Bronx Botanical Gardens in New York City, a distance of about 15 miles, to Kensico Dam at Valhalla. The development of this parkway is in charge of the Bronx Parkway Commission, consisting of Madison Grant representing the Borough of Manhattan, William W. Niles representing the Borough of the Bronx and Frank H. Bethell representing Westchester county. The work is a joint undertaking of New York City and Westchester county, three-quarters of the expense being met by the city and the balance by the county. An important feature of the parkway development work is a forty-foot driveway which will form a new



STEEL FORMS PARTLY PLACED

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*Senior Assistant Engineer, Bronx Park Commission.

APPROACH WALL AND BACKING FORM

motor traffic outlet northward from New York City. The driveway crosses and recrosses the winding course of the river on the bridges above referred to, which are generally from 35 to 50-foot span.

Bridges of the arched type were considered as being generally most suitable. Their architectural treatment has been adapted to the natural surroundings, which are typical of Westchester county's rather rugged landscapes of rocky ridges and woodlands with frequent outcropping ledges. The exterior facings of arch rings, spandrels and approach walls are, therefore, in general, quarry-faced ashlar and rubble masonry of native granite.

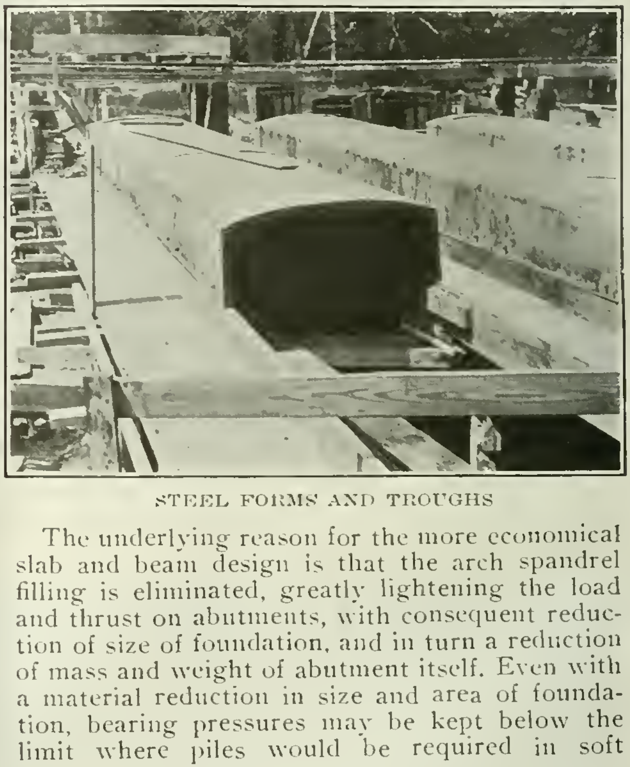
A number of bridges have already been built or are under construction and consists of the customary construction of reinforced concrete arch barrel with exterior stone facing as above described. It is the purpose of this article to describe a different type of construction that has been developed by the engineering department of the Bronx Parkway Commission and applied to bridges now under construction. This improved design consists of reinforced concrete slab and beam, floor or deck construction to carry the roadway instead of a concrete arch barrel, but still retaining the architectural treatment of exterior masonry arch ring and facing walls. The accompanying illustration of Parkway Drive Bridge No. 32 is a good example of the improved type of construction.

(Note: The plans of this bridge show an arch with a 29-foot radius, 40-foot span and 8-foot rise. The bridge has a skew of 36 degrees. This skew, however, affords little difficulty in the construction, as the only part of the structure that needs to be distorted is the under face of the voussoirs of the two cut stone faces. The skew in the slab construction is obtained by the placing of the forms as shown in the photograph. The bridge is 40 feet wide in the clear between parapets. The voussoir stones range from 10 inches to 13 inches in width and are irregular in height, varying from about 2 feet 2 inches to 4 feet. They are laid with stratification radial, beds hammer-dressed and pointed to true surfaces, and rock-faced with projections up to 1½ inches. The 22 stones in the center of the arch are about 1 foot deep measured perpendicular to the face and all others are about 2 feet. The parapet is topped with coping stones 2 feet 2 inches wide and 5 inches thick, and varying in length from 2 feet to 3½ feet, laid with stratification horizontal, top and outside edge rock-faced, laid with ¾-inch joints.

The wooden troughs and steel forms are supported on a falsework consisting of 6 x 6 posts on 6 x 6 sills carrying a 4 x 6 cap on the top of each bent. The bents are placed 8 feet apart in the clear and each bent is knee-braced to a 4 x 6 butt on the under side of the cap. The troughs are supported over each post by two 2 x 4-inch by 1-foot 6-inch wedges.

The bottom of each trough is made of 2-inch tongue and groove plank, 2 feet wide, and this is adjustable as to height by the wedges referred to, rising or falling between the sides, which are fixed in position and are formed of 2 x 10 plank. Resting on the tops of these side planks are the steel forms. The width of the forms and distance between troughs is 4 feet. On the inside of the bottom of each side of each form is a 2-inch angle iron which rests upon the top of the corresponding side plank and is tacked to it.

The main reinforcing rods in the girders are 1⅛-inch round rods, there being 6 to a girder. The stirrups are of ½-inch round iron and the stirrup spacer rods are also ½-inch and are 22 feet long. The stirrups for 10 feet each side of the center of the bridge are spaced one foot apart and for the remainder of the bridge are 7½ inches apart.)



STEEL FORMS AND TROUGHS

The underlying reason for the more economical slab and beam design is that the arch spandrel filling is eliminated, greatly lightening the load and thrust on abutments, with consequent reduction of size of foundation, and in turn a reduction of mass and weight of abutment itself. Even with a material reduction in size and area of foundation, bearing pressures may be kept below the limit where piles would be required in soft ground.

In a bridge of arched design where the character of the ground is such that piling and sheet piling would be required, it is possible by substituting a slab and beam design to so reduce the foundation pressure as to obviate the necessity for piles. On this basis, comparative estimates show that the slab and beam bridge without piles can be built for about six-tenths the cost of the arched type with piling.

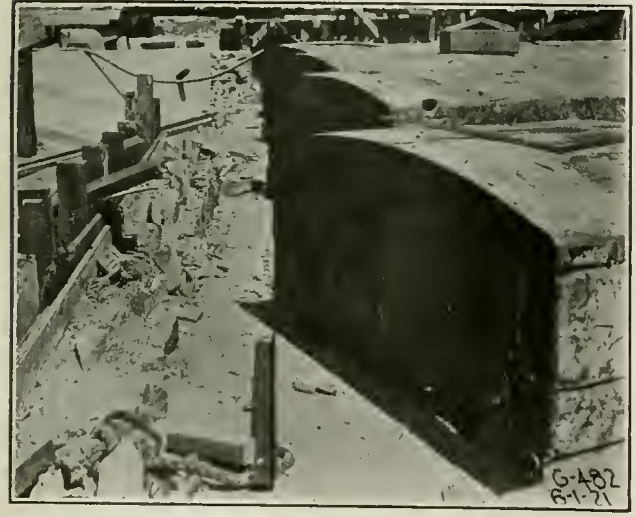
Conservative, safe design practice requires an arch to be provided with an unyielding foundation, as a small unequal settlement of abutments will result in cracks and dangerous increase in theoretical computed stresses. On the other hand an abutment supporting a beam construction may settle slightly without such serious results.

The method of construction of a bridge of this type follows the usual procedure of excavation protected by sheeting. Excavation for the approach walls may proceed at the same time as that for main abutments. When the concrete footing courses have been placed, the rubble facing masonry for approach walls is set, and granite arch rings placed on falsework. The stone facing acts as a form for the approach walls, the backing concrete being bonded to its irregular inside surface. The bonding is made more secure by hooked or Z-shaped steel anchors set between the spaces of stones and projecting into the concrete. At the proper distance behind the stone facing, inclined wooden panels are set to form the back of the wall during concreting.

When the concrete abutments have been brought to the level of the under side of the floor beams, a series of wooden trough forms are set level with the top of the abutments to form the under side of floor beams. These troughs are supported on falsework which is much simpler than the segmental falsework necessary for arch construction. Alternating with the troughs are collapsible steel forms which were used for jack arches in New York City subway construction. The accompanying illustrations show the arrangement of forms which are easily erected whether for straight or skew bridges.

Beams and slabs are reinforced with ordinary types of steel bars and expanded metal reinforcement. Concreting operations for the entire roadway system cover two days' work, half the 40-foot roadway width being placed in one day's run.

Bridges of this type have considerable architectural superiority over many of the concrete structures generally used for highway purposes. With the economical type of construction above described it is possible at small increased expense, to secure a picturesque arched bridge with some architectural merit rather than bald unadorned concrete structures. The latter are of greater strength and durability than the old steel highway bridges they have supplanted, but aesthetically are little or no better.



ENDS OF STEEL FORMS SET ON SKEW

Tracing briefly the practice of years gone by, in the use of the now nearly obsolete small steel highway bridge, brings out what is perhaps the most important aspect of the economics of the slab and beam concrete bridge with outward appearance of an arch.

The evolution from timber trusses into the steel type swiftly brought keen business competition. Energetic salesmen sold bridges solely on a lowest price basis to officials in remote counties often without competent engineers to protect their interests. These "tin bridges," to use an engineer's appellation, brought the whole breed of steel bridges into such disrepute that one state, noted for its multiplicity of reform measures, actually passed a law forbidding the erection of steel bridges.

A number of recent concrete arch bridge failures has brought to the attention of the engineering profession evidence that these structures have in turn been suffering vicissitudes through efforts to cheapen cost at the expense of safety.

The desire of economy is a very natural one, but competitive cheapening of construction below the requirements of sound engineering practice may result in disaster.

Defective foundations are a prolific cause of failures and it has been alleged by engineers that a favorite means of economy hit upon by administrative officials is the elimination of pile foundations included in the plans.

To summarize on the advantages of the slab and beam construction that has been discussed, it may be said that it provides a structure having the architectural merits and external appearance of an arched bridge but at considerably lower cost without sacrificing safety. By greatly decreasing dead load weights the necessity for piling even in fairly soft ground is avoided, with the accompanying temptation to yield to the delusion that piles may not be needed and the assumption of risks that later lead to failure.

Jacking a Large Culvert Pipe

In order to avoid breaking up the concrete pavements of the Grayson highway in Stanislaus county, California, R. B. Meikle, engineer of the Turlock Irrigation District, installed a 36-inch corrugated steel culvert pipe, 60 feet long, by jacking it through the base of the embankment on which the highway was constructed, without any excavation from above.

The pipe was made up of 3-foot sections, the first of which had a 12-inch forward extension reinforced by a circular end rod to form a cutting edge for the driving shoe.

PLACING CONCRETE

The pipe was installed in a trench transverse to the embankment, and was forced under the latter by a 50-ton jack, reacting against timber blocking at the end of the trench. As the pipe penetrated the earth the loose material was washed out with a water jet and when stone or hardpan were encountered they were loosened with a crowbar operated by a man entering the pipe.

After the first section had been driven, a second 20-foot section was riveted to the rear end and both together were pushed forward as the first had been, and the operations repeated with the third section, completing the work in ten days with three men. The pipe was not distorted or otherwise injured, 'and the work was done at about the same cost as by ordinary open-cut methods, and with the advantage of no interruption to traffic and no injury to the concrete pavement.

Licensing Engineers

On January 4, 1921, a petition was filed in the Massachusetts Legislature by the Boston Chapter of the American Association of Engineers, accompanied by a bill to provide for the registration of professional engineers and land surveyors. This aroused an immediate protest by the Joint Committee on the Licensing of Engineers, consisting of representatives of the Boston Society of Civil Engineers, the Boston sections of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, American Society of Heating and Ventilating Engineers, American Institute of Mining and Metallurgical Engineers, the Boston Society of Architects, the Boston Society of Landscape Architects and the Boston Chapter of the American Association of Engineers. On January 7, this committee voted "that legislation relative to the registration of architects and engineers by this year's session of the legislature should not be recommended; second, that the Boston Chapter of the American Association of Engineers be requested to withdraw, for this year, its bill filed with the legislature to regulate the practice of the profession of engineering and land surveying."

This report was signed by all of the members of the committee except the representative of the American Association of Engineers. The association did not withdraw its petition and bill and a hearing on the bill was held by the Committee on Mercantile Affairs of the Massachusetts Legislature on February 18, at which hearing only representatives of the American Association of Engineers appeared for the bill and representatives of seven other societies opposed it. Following this hearing, the legislative committee recommended the bill be referred to the next annual session of the legislature, and this recommendation was adopted by the Senate on February 24 and by the House on March 3.

At the hearing, both the form of the bill, which contained many glaring defects and inequalities which were contrary to the spirit of appropriate legislation, and the principle of registration itself, were vigorously opposed and it was made plain to the legislative committee that only a few of either the public or the engineers were at all interested in having the bill passed.

According to the joint committee, the reasons stated in this bill, as in others urged by the American Association of Engineers before various state legislatures, were that they would safeguard life, health and property in the hands of engineers. Professor George F. Swain pointed out that these were at present safeguarded in Massachusetts by competent commissions and engineers through building laws and other special laws requiring official supervision and approval of plans and that no possible method of registering engineers could take the place of these measures or provide safeguards to society more effectively. Public and private interests are better safeguarded, he said, by selecting an engineer on the basis of his professional reputation and work accomplished, than by virtue of his holding a license.

It was demonstrated at the hearing that a person who registered under the proposed bill would be, in the eyes of the law, fully competent to practice every branch of engineering, regardless of the field in which his training or experience had been. Most of the registration laws make no distinction between different fields of engineering activity, although a man registered as an engineer and whose principal knowledge is confined to mechanical engineering is little better qualified than would be a lawyer or a physician to pose as a chemical, electrical or efficiency engineer.

If licenses are issued to men of mediocre or inferior ability, many such would obtain licenses and have the same standing before the public as those of much greater professional attainments and reputation, with the result that public and private interests would suffer from work of inferior quality.

As to reciprocity with other states, one state cannot compel another to recognize engineers registered in the former and the requirements for registration would be much higher in some states than in others, thus defeating mutual reciprocity.

Another argument advanced against registration is the difficulty of defining an engineer, no effort at such definition yet having proved acceptable. "It is a question how laws can be framed to effectively and properly regulate anything that cannot be definitely and comprehensively defined."

Some at least of the registration laws require that applicants for registration be citizens of the United States or of either the United States or Canada, which would make it impossible to employ in this country British, French or other foreign engineers in connection with big undertakings.

The above are the principal arguments advanced by those who opposed the adoption of the bill before the Massachusetts legislature.

Connecticut State Highway Maintenance and Repairs

Organization of State Highway Department. Apportionment of funds of $10,000,000 yearly. Distribution and charges for equipment. Character and cost of classified repairs.

The state of Connecticut is sixty miles wide and about 110 miles long. Its population is 1,200,000 and the assessed valuation is $1,936,473,275. There are about 12,000 miles of highways, 10,400 miles of which are unimproved, 1,600 miles under state control, and only about 75 miles paved with concrete.

This costly and important work will be designed, supervised and maintained by the well-established technical and executive organization of the State Highway Department that has been developed to handle the problems of most efficient, economical and durable construction and maintenance that have been involved in the great changes of requirements and conditions that have arisen in the few years since the introduction of automobiles and the fewer years since their extensive use for heavy trucking. The department has adopted a rational policy of co-operation with Federal and county work tending to constantly improve the entire system, maintain balanced developments, preserve and extend improvements, establish practical and improved standards with flexibility for local conditions that is carried out by a permanent corps of well-trained employees, promoted for merit to secure and reward efficiency unhampered by political interference.

ORGANIZATION OF DEPARTMENT

State Highway Commissioner, Charles J. Bennett.

Deputy Highway Commissioner, Richard L. Saunders, in charge of construction.

Superintendent of Repairs, W. LeRoy Ulrich, who has charge of maintenance.

Chief Clerk or Chief Accountant, Clinton G. Nichols, who has charge of the accounting, bookkeeping, etc., for both branches.

Under the deputy commissioner, who is in effect the chief engineer of the department, comes the drafting room and five division engineers. They operate all the contracts for road construction or reconstruction of contracts are operated by that branch of the department.

The bridge department is under the deputy commissioner, but the construction of bridges comes under the division engineers. Anything in the way of a bridge, from a 12-inch culvert to a $1,500,000 bridge is constructed.

Under the superintendent of repairs, there are eleven supervisors of repairs who carry on the ordinary repair and maintenance of highways through their own forces employed through foremen and sub-foremen under these different supervisors.

The department has the right to condemn property. The law gives the highway commissioner the right to determine the amount or consideration the property is worth, making an offer to the owner, who can take it or not, but the Highway Department can occupy immediately after making the offer and litigate after. The litigation of the department is carried on at the present time by the Attorney-General of the state.

The accounting system takes in the central part of the department which is in Hartford and reaches out into the accounting systems of engineers and supervisors to get their accounts into the books of the department.

There is maintained a testing laboratory in connection with the city of Hartford. The chemist of the city of Hartford is the chemist of the State Highway Department also.

There are eleven districts, each one in charge of a supervisor of repairs. These districts are divided into sections. There is no particular length of road in a section, the size depending upon the character of the road and what one gang can take care of. The average gang is four or five men throughout the year. Ordinarily each gang has a motor truck. The state owned 60 before the United States Army gave any, and there are about 135 or 140 now. The supervisor has entire control of his district. He reports directly to the superintendent. The section foremen have entire charge of the roads in their section and report to the supervisor. The foremen are competent to do all the repairs that are necessary, and are authorized to make repairs by the supervisor, who covers the district once or twice a week. The superintendent of repairs has charge of maintenance work for the entire state. The assistant superintendent of repairs reports directly to the superintendent of repairs and the superintendent reports to the commissioner.

BUDGET

Automobile receipts, from which the funds of the department are largely derived, come in little by little, right through the year, the bulk coming in January and February, probably over 60 per cent, as most all of the cars are registered in January.

The cost of all maintenance is estimated in advance, based on the figures for the four or five years preceding. The state is divided into eleven districts, and each district is divided into sections, depending upon the topography of the country and the class of roads in that section. The figures for the preceding years and the conditions of the roads are used each year as a basis for estimating the requirements necessary for each town for the coming year. What it will cost for ordinary maintenance; cost for oiling; cost for state aid work, etc.

These are prepared in the form of allotments to each supervisor in charge of a district; he is sent an allotment, and keeps track of it. It is practically a daily inventory proposition.

The supervisor in charge of any district knows how much money he has left in a certain town. He can tell how much he figures he will have to spend each month to keep the roads in repair, and if any extraordinary work has to be done, he will cut down on his expenses for a later month. Each man knows exactly how much money he has to spend when he starts in and must cut his cloth accordingly. The year is divided into twelve months, and the approximate percentage spent during the year by months is shown on the attached chart.

EQUIPMENT

On gravel roads, drags, calcium spreaders and all miscellaneous small tools, such as hoes, picks, shovels, etc., are used. For the bituminous surfaced road, there are tar kettles, and all the larger equipment which in what is called "various account," is held by the state as a whole, and whenever a man needs more than he has, this apparatus is sent to him, and he pays for it while he has it. Take the trucks, for instance. Every day that the man uses the truck he pays the state of Connecticut a fixed charge. Against the truck is charged the driver, oil, gas and all supplies. If he earns money for the truck, he sends the department a check; if he loses money, the department sends him a check to pay his bills. The district supervisor rents trucks from the state of Connecticut just the same as from an outside party. The per diem charges are $14, $16, $18 and $25 for 1, 1½, 2 and 3-ton trucks, respectively.

Oiling truck charges are $45 to $50 a day. These work a short season and are expensive trucks. Ordinarily the men come out creditors in renting these trucks. The earnings of the truck with its estimated value are indicated on a chart. The majority of them show a profit. If any trucks fall materially below the profit line, they are investigated and the trouble is corrected before the trucks are withdrawn. Every item is kept track of excepting interest on the investment.

The storage plant at Portland, Conn., is centrally located and maintains all of the equipment required for maintenance excepting what is permanently furnished to the different districts. There are there a number of trucks, a steam roller, one or two loaders, pipe, lumber and all kinds of tools and automobile parts. Five or six men are employed there, some carpenters and other mechanics. They build bodies for trucks, etc.

CHARACTER OF REPAIRS

The principal repairs necessary on the surface of the concrete road are the tarring of joints. Of course, the shoulders, railings and culverts on the concrete road require the same repairing as any other road, and take the same amount of work. Approximately $350 per mile is the ordinary cost for repairing concrete roads, and for the concrete surface alone at least $100.

For mixed bituminous roads, including sheet asphalt, Topeka and Warrenite, the repair figures vary with the traffic. On certain parts of the Post road the cost will run up to $3,000 or $4,000 on account of the excessive traffic and lack of foundation, the road being built on an old macadam road. In other sections where there is a concrete base with mixed bituminous top, it will probably average $500 or $600 per year; $500 is the minimum charge for repairs on a bituminous macadam road.

BITUMINOUS ROADS

A portable plant is used where the patches are made by force account, but there is so much of this work that a great deal of it is done by contract.

STATE OF CONNECTICUT
Highway Department

EXPENDITURE CHART

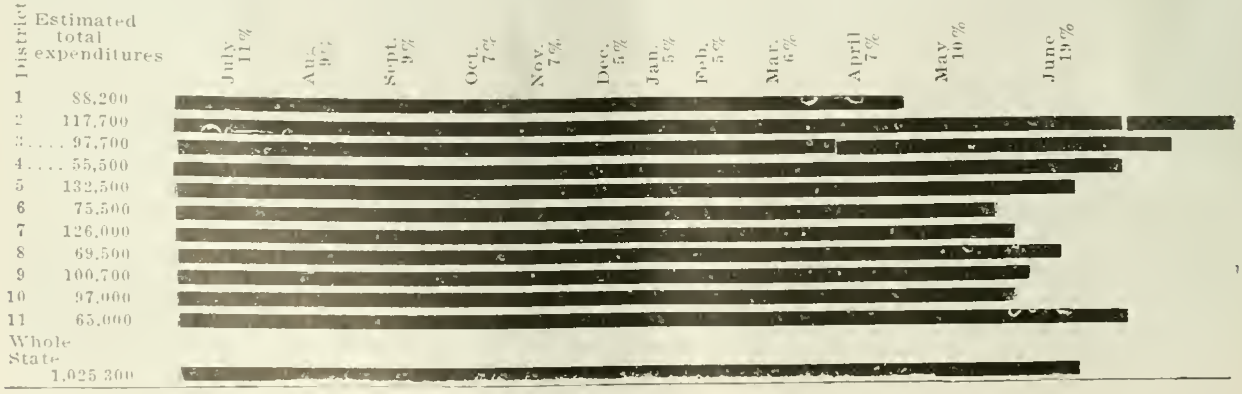
Trunk Line Repairs Ordinary

For Period Ending April 30, 1921

1920-21

W. LeRoy Ulrich, Supt. of Repairs

Charles J. Bennett, Highway Comr.



The patch is cut out square and the hole is filled with the same material as in the original road, which is placed hot and rolled.

The state owns and maintains an asphalt plant, which gets out 60 to 70 tons a day, but it buys the majority of the material, which is easily available at a great many sources, including commercial plants at Hartford, Meriden, New Haven, Bridgeport and Stamford.

WATERBOUND MACADAM

The entire cost of repairing will run from $1,000 to $2,000 a mile, depending on the condition of the road itself, how old it is, and how it was originally built. Sixty per cent of the state system is macadam road.

GRAVEL

Gravel roads will run from $750 to $1,200 per mile per year. They are a little less expensive to maintain than macadam, but do not present as good a riding surface the year round. For nine months of the year they are as good as macadam, and they are cheaper to build in the first place. but will not stand up under traffic. The state is building practically none at this time.

About 10 per cent of the system are dirt roads. One section of eleven miles, along the Connecticut river, costs $2,000 a mile to maintain. This is a trunk line with heavy summer traffic. In other places, where traffic is light, the upkeep costs very little. On the River road, however, it is a case of continual dragging, the traffic being very heavy from Saturday morning until Monday night.

The regular road maintenance includes the removal of snow for the full width of trunk lines, and, afterwards, from state aid lines.

CLASSIFICATIONS OF AMOUNT AND COST OF REPAIR WORK

A record of state aid repair work from July 1, 1919, to June 30, 1920, that was done in 168 towns, comprised 164 miles grading, 139.16 miles gravel, 30.01 miles stone surface, 237.27 miles macadam, 42.61 miles bituminous macadam, 7.98 miles bituminous concrete, 23.05 miles concrete, 0.78 miles brick and granite blocks, making a total of 581.41 miles at an ordinary cost of $306,345.05; extraordinary cost of $94,287.08, and a total expenditure of $279,749.89. Of this sum there were refunds and adjustments amounting to $810.74, leaving a net expenditure of $278,939.15, exclusive of the state oiling, $121,992.18, making a total net cost of $400,932.13. The ordinary repairs amounted to $24,227.85 and the maintenance to $282,417.20.

For the same 168 towns the trunk line repairs during the same period amounted to 99.70 miles graded, 209.39 miles gravel, 48.40 miles stone surface. 393.43 miles macadam, 40.46 miles bituminous macadam, 107.56 miles bituminous concrete, 76.18 miles concrete and 0.88 miles brick, wood block and granite block pavement, making a total of 975.95 miles repaired at an ordinary cost of $1,070,203.97; compensating payments $44,879.61 and accident payments $206.18. The extraordinary costs were $64,955.62, the state aid oiling was $121,992.98 and the total expenditures, including compensation payments, accident payments, and $341,784.85 for supervision and equipment. amounted to $2,287,607.49.

Hackettstown-Budd Lake Highway

Extensive equipment for the construction of a $700,000 section of concrete highway 6.6 miles long through very rough country with young men under guard from Rahway Reformatory that give excellent satisfaction

---

Section 2, Route 5, of the New Jersey State Road System is 6.6 miles long and extends from Hackettstown to Budd lake, through a very rough country where all but half a mile is in a new location, much of it terraced out of the hillsides and having many 6-degree curves and some grades up to 6 per cent. The line crosses several bad swamps and runs through considerable heavy timber that necessitated clearing and grubbing 17 acres. The road has a concrete pavement 20 feet wide, from 6 to 8½ inches thick, crowned 2½ inches and made of 1:2:4 concrete placed directly, without other foundation, on subgrade compacted and finished to within ¼ inch of the required level.

QUANTITIES AND STATE LABOR

The principal quantities involved are 59,500 yards of excavation, including 6,000 yards of rock, 31,000 yards of extra embankment, 74,211 square yards of concrete, 5,000 square yards of cobble paved gutter, 4,000 linear feet of reinforced concrete culvert pipe from 12 to 30 inches in diameter, 1,000 feet of 6-inch vitrified French drain pipe, 20,000 linear feet of wood guard rail, and eight concrete arch bridges of from 10 to 30 feet span. The estimated cost of the work, exclusive of the bridges, is $700,000. It is being executed by the New Jersey State Highway Commission under the direction of T. J. Wasser, State Highway Engineer.

The work is being executed with equipment owned by the state, a part of which was recently turned over to the commission by the War Department of the United States. Most of the labor is provided by 100 young men under 21 years of age, detailed from the Rahway Reformatory, who are under constant supervision by keepers who maintain excellent discipline. The men are willing, cheerful and contented, do very good work, and are considered satisfactory and much superior to ordinary convict labor. There are also 4 foremen, 3 mechanics, 12 truck drivers and 26 paid laborers, mostly employed on the steam shovel work.

The grading is heavy and difficult and includes a great deal of boulder excavation, where many of the boulders have to be block drilled and blasted and when the stones are so numerous and have so little soil between them that it has been necessary to draw on extra earth to fill up to subgrade. The excavation is mostly steam shovel work, much of the spoil being cast alongside and downhill by the shovel and not requiring transportation, although in some cases excess of embankment requires earth to be dug from borrow pits and hauled up to the fill.

On July 15, 30,000 yards of excavation had been completed and about 16,000 square yards of concreting, and had attained a regular progress of about 260 linear feet per day.

STORING, MEASURING AND TRANSPORTING AGGREGATE

Storage for 800 yards of aggregate is provided for at headquarters, where a side hill has been cut to a vertical face and retained by crib work 20 feet high, on which a branch road is located, permitting automobile trucks to bring sand and gravel and dump them from the top of the cribbing to surface storage piles, whence they are reclaimed by ¾-yard clamshell buckets operated by a 66-foot derrick boom that fills the elevated storage bin of 50 tons combined stone and sand capacity. There are 60 steel bottom-flap batch boxes of 27 cubic feet capacity, that are placed on flat cars under the storage bins and filled up to a certain mark with sand, gravel and cement, hauled, in 10-car trains, by Plymouth gasoline locomotives and delivered to the Koehring 1-yard mixer.

The 24-inch service track running the full length of the road, is laid with 25-pound rails spiked to wooden ties and has ten 300-foot sidings, long enough to accommodate two 10-car trains. It is thus intended to maintain continuous operations in concreting with one train of cars being filled at the storage bins, another delivering materials to the concrete mixer, one train being hauled to the mixer and one train returning or side-tracked to pass the full train.

Cement in bags is stored in a 16 x 60-foot house having a capacity of 10 carloads. Reinforcement which consists of galvanized American wire mesh is received in rolls 4 feet wide that are stored under cover and before use are flattened by passing through a set of straightening machines similar to boiler makers' rolls, being rapidly pulled through by a tackle operated by a gasoline engine and thus straightening the fabric at the rate of about 200 squares per hour.

Excavating is done with two ¾-yard steam shovels served by nine 5-ton White automobile dump trucks making an average haul of 1 mile.

PLANT AND BUILDINGS

Besides the items already mentioned, the principal articles of equipment include 62 flat cars, one 12-ton Buffalo-Pitts roller, one 5-ton International tractor hauling a Champion blade scraper, 5 Syracuse plows, 4 Syracuse rooters, three 350-gallon centrifugal pumps, besides plunger pumps, 5 Foos and Novo force pumps, all with 2-inch discharge pipes supplied from convenient ponds and creeks and pumping into a main line 5 miles long that is equipped with relief valves set to maintain a maximum working pressure of about 50 pounds. There is also 1 steam and gasoline pump for unwatering bridge foundations and two well pumps to provide the camp supply, which is stored in a 3,000-gallon wooden tank on top of a wooden tower 8 feet high.

There is a Koehring ½-yard and a Little Wonder ½-yard mixer for bridge and culvert concrete, and there are ten team-drawn dump wagons and three 3-ton motor trucks with cargo bodies.

The 14 x 20-foot stock room is filled with general supplies and the 16 x 20-foot office accommodates the desk and books of the cost clerk and time-keeper.

There is a 16 x 16-foot engineers' office and a magazine, where there is maintained a supply of about 500 pounds of 40 per cent dynamite in 1-pound sticks replenished every week or two as required.

The camp contains 6 acres, has a 34 x 144-foot one-story wooden dormitory building, furnished with 100 steel cots, and adjoining it is a 16 x 20-foot lavatory with wash trough, basins, showers and water closets. The camp has a complete sewerage system with a 7-foot septic tank and two 100 x 100-foot filter beds used alternate days.

The 34 x 34-foot mess hall seats 100 and is served by a kitchen at the end of the 24 x 96-foot guard building that also contains a guard dining room for 25 men and general sleeping quarters, and the office for the chief of the reformatory deputies. This building is supplemented by a 10 x 10-foot extension containing toilets, shower baths and wash basins.

There is a 27 x 100-foot truck shed with 10 stalls and a 27 x 27-foot garage for the two Ford passenger cars and a motorcycle and the repair and supply room.

There is a 15 x 15-foot smith shop and a 15 x 15-foot oil house containing about 200 gallons of lubricating oil and a 560-gallon underground gasoline tank.

Shifting a Dump Track

At the plant of the U. S. Portland Cement Co., near Davenport, Iowa, there has been made a shallow fill with quarry waste delivered to the site in 6-yard side dump cars, hauled by a locomotive. As fast as the face of the dump advanced, the ties were jacked up above the surface and the track was bodily hauled transversely to the edge of the fill by a stump puller, operating two lines attached to the track and to a parallel anchored cable secured to deadmen 50 feet apart and affording connections at any point to suit the requirements of the track shifting. The anchored cable served for a long time in one position for most rapid and convenient attachment and the methods employed saved considerable labor.

A Hoisting Tower Water Tank

The head works of a colliery at Liegé, Belgium, has been utilized for the support of an elevated reinforced concrete water tank of 9,000 gallons capacity, which is reported to have been built at a cost of only about $300 above what the cost of the tower itself would have been without the tank. The tank is ornamented with pilasters and Gothic arches in the facades, has a crenelated parapet, and little minarets at each corner, giving it an attractive appearance. No further data are given so the inference is that the tank was constructed with the hoisting tower and to provide water for colliery purposes.

PUBLIC WORKS

Published Weekly
by
Public Works Journal Corporation
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba.$3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
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FRANK W. SKINNER, Associate Editor

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Arch Faces for Slab and Beam Bridges

Where any regard is had for appearances in planning public improvements and their surroundings, and especially in parks, every effort is made to utilize to the utmost any streams or other bodies of water as attractive features of the landscape. Consequently in such locations the bridges should be carefully designed with a view to artistic lines and appropriateness to surroundings. Under most conditions nothing has been found that equals the arch for beauty of lines, while rough stone harmonizes with rustic surroundings better than any other materials, although dressed stone or concrete may be more appropriate for situations where all the surroundings are artificial.

An arch bridge, however, requires natural or artificial foundations capable of receiving both vertical load and arch thrust with no appreciable yielding; and if the soil be soft and deep, this involves considerable expense for piles or other foundations, and unless experienced engineers prepare the plans there remains even then the possibility that the bridge may fail.

Such a soil condition was found along the Bronx river by the Bronx Parkway Commission, and its engineers, after studying the problem carefully, decided to bridge the river with concrete slab and beam construction, resting on end abutments with all pressures vertical, and build on each side of the bridge a face of stone masonry in the form of an arch. The resulting appearance is shown by the photograph on the front cover of this issue. While close inspection shows the vertical abutments between the two thin arch walls, at a distance this is not noticeable and the effect is very pleasing; much more so, certainly, than would be that of a slab and beam bridge with its severe straight lines.

It has been said that the introduction into a structure of an arch, pillar or other feature that serves no structural purpose, cannot be used to produce an artistic effect; and some may criticize this design from that point of view. But inasmuch as the arch is the most appropriate structure for a bridge in such a locality, and as the effect produced is most pleasing so long as the real construction is not discovered, the deception would seem to be justified under conditions such as these found in the Bronx Parkway.

Budget System of Highway Maintenance

A complete system of methods, operations, costs and records for the maintenance and repairs of about 1,600 miles of state controlled roads in Connecticut has been thoroughly worked out and is in satisfactory operation. This includes about 175 miles of concrete and bituminous concrete roads, 450 miles of stone and bituminous macadam and the remainder of stone, gravel, and earth or combinations of them, all of which are treated with oil, tar or calcium chloride. During the present year these roads will require an expenditure of about $2,000,000 for maintenance and repairs, exclusive of bridge work, construction and reconstruction.

This work has been systematized so that it is promptly and continuously conducted, intelligently, directly and efficiently executed in such a manner as to prevent serious deterioration, or undue expense, to be justly apportioned to rural, urban and surburban localities in different parts of the state, to be under constant supervision and to be recorded so that conditions and amounts can be quickly determined from inspection, to give classified costs and to maintain them within the available funds.

These results are effected by a system of organization that divides the state into districts that are subdivided into irregular numbers of sections of varying sizes that are constantly patrolled by experienced men who constantly note varying conditions, as fast as repairs are required order them done by competent 4 or 5-men gangs that can do ordinary repaving without special instructions or supervision under the general direction of the supervisor, who inspects all the roads in his section once or twice a week.

The supervisors report through the assistant superintendent and superintendent to the state commissioner. Daily reports are made and the central department calculates the costs and from those of the preceding year, compared with local conditions and the requirements developed, prepares in the beginning of each year an estimate for the work likely to be needed in each district during the year. On it there is made a pro-rata allotment of the available funds, which are then delivered to each district supervisor, who is expected to direct the work accordingly, making each month of the year conform to its respective share of the allotment, increasing or decreasing them if necessary to secure a final balance. State equipment is issued to the different districts and they are charged per diem rates for its use, and credited with disbursements.

Under this system it has been found that the minimum average annual costs of repairs and maintenance are: For concrete surfaces, $100; for mixed bituminous roads, including asphalt, $500; for waterbound macadam, $1,000; for gravel roads, $750; and for dirt roads under favorable circumstances only a very small sum is required, chiefly for scraping.

The records of this system are valuable factors in designing new reconstruction so as to balance maintenance and interest of construction in a way to secure the lowest final costs for satisfactory roads of different types.

Finances of Municipal Bond Sales

The Philadelphia Bureau of Municipal Research, following the recent sale of bonds by that city, has discussed the disadvantages just now of issuing long-term bonds, as follows:

The sale by the city on July 18 of an issue of $5,000,000 of 50-year 5½ per cent bonds of the city of Philadelphia at 104.139 and accrued interest was undeniably successful. The large premium received; the fact that more than seventy separate bids were submitted, totaling more than three and a half times the amount of the bonds offered by the city; and the fact that three banking syndicates competed at substantial premiums for the entire issue—these and several other facts made the sale one of the most successful that the city has ever had.

Had the city offered these same bonds at 6 per cent interest, instead of at 5½ per cent, the sale would have been vastly more successful. The city would have received about $650,000 in premiums, instead of $206,950; and there undoubtedly would have been a very large increase in the number of bidders and in the total amount of the proposals submitted. Such a sale would have been heralded as a most wonderful demonstration of the high credit of the city and of the desirability of the bonds as an investment.

Let us not be carried away with first impressions. Let us get down to bedrock. Let us see whether this hypothetical sale is a better indication of the credit of the city than was the actual sale. Let us go a step farther and see whether the actual sale is a better barometer of the city's credit than a sale of those same bonds at 5¼ per cent would have been.

The truth of the matter is this: The hypothetical sale of the 6 per cent bonds, the actual sale of the 5½ per cent bonds, and the hypothetical sale of the 5¼ per cent bonds would, in all probability, have measured the city's credit at substantially the same mark. The 5½ per cent bonds were sold by the city to the banking syndicate on a basis of close to 5.27 per cent, and resold by the syndicate on a basis of about 5.19 per cent. In other words, the cost to the city on this $5,000,000 of bonds is 5.27 per cent per year, not 5½ per cent; and the income to the investors is 5.19 per cent per year. Any $5,000,000 of bonds sold at the same time, whether the interest were 6, 5½, 5¼, 5 or some other per cent, would have been taken by bankers and by investors on substantially the same bases, 5.27 per cent and 5.19 per cent, respectively, and would have cost the city about the same rate per year as the 5½ per cent bonds that were sold will cost.

Not for more than forty years has the city floated an issue of bonds bearing so high a rate of interest or costing so high a rate per year. To commit the city to this high cost for so long a time is hardly careful stewardship. Wisdom should have dictated the avoidance of such a costly committal. In anticipation of lower interest rates later on, and of the consequent opportunity to refund the bonds at a lower yearly cost, the city should have reserved the right to redeem them at par at the end of, say, five years, or on any interest date thereafter. Had it done this, of course it would not have received nearly so large a premium, but it would have been in the highly advantageous position of saving hundreds of thousands of dollars of the taxpayers' money within the 50-year period.

For a present premium of $206,950 the city has placed itself in a position whereby its hands are tied and it is prevented from saving many times the value of that sum.

Verily, the city, like Esau, has sold its birthright for a mess of pottage.

July Building

In the 27 northeastern states of this country construction activity in July amounted to $212,491,000, which, according to F. W. Dodge Co.'s review, is 7 per cent less than in June and 4 per cent greater than in July, 1920. In the same territory the construction during the first seven months of the year has amounted to $1,278,747,000, which is 10 per cent greater than the average for the corresponding time of the preceding five years.

In the New England states the building contracts amounted to 28 per cent more than in June, but in New York and part of New Jersey 15 per cent less than in June. In the middle Atlantic states, in the Pittsburgh district and in the central west they were also less than in June, but in the northwest they were 30 per cent greater than in June.

Fall Letting of Highway Contracts*

A plan to increase production and lower overhead.

A vast amount of waste and inefficiency in highway construction, much of it avoidable, is attributed by engineers and contractors engaged in that industry to the present practice of awarding contracts in the spring. The investment in equipment used in Illinois in 1919 is estimated at approximately six million dollars, yet this equipment was able to operate at capacity for but one week during the season. A record of lettings in Iowa over a period of ten years shows that the average date of letting was April 15, and that concrete was poured about a month and a half later. Since a phenomenal development of roads has introduced elaborate specialized equipment and has occasioned a yearly expenditure exceeding the cost of the Panama Canal, the matter of longer seasons is an important consideration.

ILLINOIS' EXPERIENCE IN 1920

In 1919 the first contracts for Illinois roads were awarded early in May, and but little concrete was placed before July. Production steadily increased until October, when the maximum output was reached. One week after reaching the maximum it dropped off rapidly to zero. On account of the late date in arriving at capacity production, only 172 miles of road were built, and about 600 miles were carried over to the following year, uncompleted. The results of that year, however, were radically different. Conditions in 1920 were approximately those existing under fall letting. Very few contracts were let in the spring, and by reason of work carried over constructors were able to begin operation at the first opening of spring. In consequence of this early start, concrete work began in April, two months earlier than in the previous year, and reached a heavy volume by June. During June transportation failed and the lack of materials disrupted the work. Had this not occurred, the indications are that peak production would have been reached in July and continued with slight fluctuations until October.

In spite of the transportation failure, about 350 miles of pavements were laid and but 192 miles left uncompleted. This means that in 1920, when construction companies were able to start early and with well-laid plans, they built 100 per cent more road than in 1919, and did it in spite of the most trying transportation difficulties.

The customary procedure of most State Highway Departments has been to ask for bids in the spring—often as late as May. The average number of working days in the central states under spring letting has been found to approximate from 110 to 120, and since the fourteen weeks lost contain twenty-five or thirty days on which weather conditions permit work, the seasons might readily be increased 20 per cent.

It is proposed that State Highway Departments call for proposals and award their contracts during the fall. This procedure is desired not only to extend the working season but to develop the possibilities of interseasonal work.

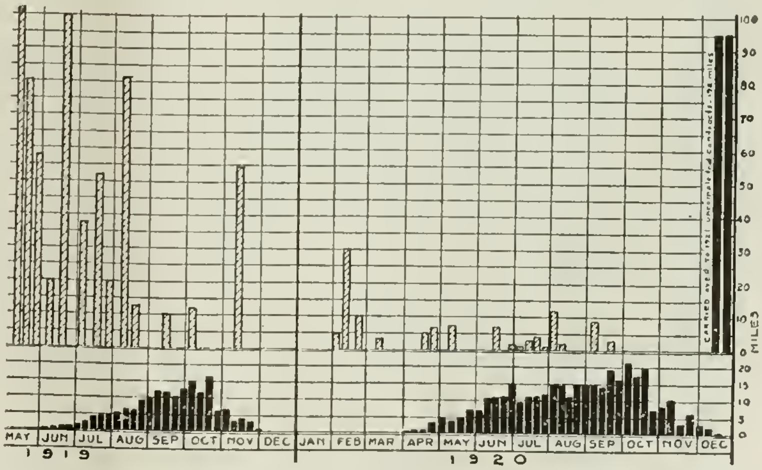
DISADVANTAGES OF FALL LETTING

The objections to fall lettings are: First, in a declining market the state would pay more for work under fall contracts than those awarded the following spring; and, second, the highway departments need a slack season in which to make surveys and plan their projects for the coming year. When prices are practically stabilized this consideration, of course, would not enter and the economies otherwise effected would probably outweigh any minor changes in material prices. The second objection pertaining to the need of highway departments for a slack season in which to plan and make surveys, was not considered serious by the engineers consulted, as they felt that state departments might readily readjust their organizations to handle the work.

ADVANTAGES OF FALL LETTING

The advantages are as follows:

1. Relief of car shortage between July and October.



WEEKLY RECORD OF ROAD PAVING IN ILLINOIS

Upper diagram shows mileage of contracts awarded; the first items being 145 miles, 45 miles beyond limit of diagram. Lower diagram shows completed pavement, 171.1 miles in 1919 and 347 miles in 1920.

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*Excerpt of paper prepared upon request of Herbert Hoover, Secretary of Commerce, by the Research Department of the Associated General Contractors of America.

2. Employment of labor in slack months.
3. Reduction of seasonal fluctuation in construction.
4. More continuous production of materials.
5. Increased efficiency in road building.
6. Completion of highways as planned by state departments.

RELIEF OF CAR SHORTAGE

Transportation constitutes probably the most difficult item with which road builders have to contend, and if any means is found whereby a steady supply of materials can be assured, great economy will be introduced. Such a means can at least in part be furnished by beginning work early in the spring—thus starting the movement of materials at an early date and reducing the peak demand for open-top cars in late summer. It was this peak demand, contributed to by all industry, which disrupted construction in 1920.

Recent reports from the carriers show that they now have 134,000 cars less than at the transportation peak of 1920. Therefore, it is essential that every industry take action, wherever possible, towards relieving the congestion of late summer. If contracts were awarded in the fall, construction companies could not only give aid in the transportation problem by making certain shipments in winter and spring, but could also give continuous employment to a part of their employees.

SLACK SEASON EMPLOYMENT

On account of the seasonal character of construction, which is one of the most seasonal industries, each year witnesses an enormous fluctuation of activity. In those states which are not favored by a mild climate, an elaborate organization is assembled in the spring and a few months later is scattered as work closes down in the fall.

Any action whereby more continuous employment can be furnished will doubtless draw more competent men into construction and raise the efficiency of those already so engaged

Construction companies could, if awarded contracts before winter, so lay out and execute their preliminary work that winter employment could be given to a considerable number of men. Heavy grading could be carried on, materials could be stock piled to insure a continuous supply, and material distribution plants could be assembled. In this way the preliminary work could be completed before concreting weather arrived, and capacity output could be reached early in the season. Each part of the work that can thus be carried on during the off-season helps to stabilize construction activity.

SEASONAL FLUCTUATION IN CONSTRUCTION

Elimination of the waste in any industry which results from spasmodic or heavy peak demands for production, has for many years been the subject of careful study by public service and other corporations, but until very recently, the same factors in the construction industry have received but scant attention. And yet it is doubtful if any other industry offers a more fruitful field for improvement in peak load inefficiency.

Construction activity in the central and northern states must, on account of climatic conditions, be subject to wide variations. But even in those states the amount of work that can be performed outside of the period now commonly regarded as the construction season, is sufficient to materially reduce the almost feverish activity of late summer and autumn, and by such reduction to affect the economies which arise from more uniform operation.

CONTINUOUS PRODUCTION OF MATERIALS

By lengthening the construction season the operating season for various producers of material is also increased. Two months added in the spring to construction would mean also two months added to the season for producers of gravel, crushed stone, and brick. Their overhead cost would be reduced accordingly and would reflect in the cost of finished roads. Material producers, like construction companies, would be better able to anticipate the market, provide for equipment and lay plans for adequate production.

INCREASED EFFICIENCY IN ROAD BUILDING

Considerable heavy grading can be done between the months of November and April, thus enabling a construction company to retain the nucleus of a permanent field organization. These men could be utilized also at other preliminary work to eliminate much of the dead time in winter during which the permanent field organization draws pay. Another saving can be made in equipment expense. Contractors, upon completion of their work in the fall would not find it necessary to remove their equipment, ship it to the storage yard and then reship it in the spring, but could ship direct to new work. The freight of at least one shipment, and loading expense involved, are in that event eliminated.

Probably the greatest improvement is made possible by the opportunity offered for careful investigation and planning during the slack winter months, and the possibility of retaining a larger number of well-trained men. Any plan whereby construction companies will be enabled to retain mechanics and instruct them over winter will react to increase efficiency.

COMPLETION OF HIGHWAYS PLANNED

The efficiency of a road-building unit, while of interest to the state highway engineers, is not their most vital concern. They are interested first in seeing that the state receives the road which it contracted for and receives it on the date expected. Very few contracts in the last two years have been completed on time. If the conditions of 1920 in Illinois could be approximated in other states, that is, if work could start without the usual delay of spring letting, several contingencies of construction would be avoided, and the various highway departments would doubtless be able to carry out their work as planned. The opinion has been expressed by engineers of the Illinois Division of Highways that, had the material supply not failed it would have been possible with the early start of 1920 to build twice the mileage constructed that year, and build it, moreover, without additional administrative charge and with very little additional overhead expense to the constructors. The conditions anticipated by engineers and contractors have been so closely verified in Illinois under conditions assimilating fall letting that its advantages are no longer to be doubted.

Highway Notes

During the years 1919 and 1920 the state of Oregon expended $20,000,000 for highway construction, including $1,200,000 Federal Aid money for forest and post roads. Most of the work done was on the Columbia river and the Pacific highways, adding nearly 686 miles of grading, 395 miles of rock and gravel and 363 miles of paving, besides which there are now under contract 300 miles of grading, 250 miles of rock or gravel and about 60 miles of paving.

During 1920 the state of Iowa built 5 miles of steel bridges, nearly 1 mile of concrete bridges, and 62½ miles of culverts, at an aggregate cost of more than $9,000,000.

Expansion of Drawbridge Prevents Closing It

On July 29, following the intense heat that had lasted for several days, the steel draw spans of the Newark turnpike and Lincoln highway over the Hackensack river, New Jersey, were so lengthened by heat expansion that it was found impossible to close them, and one was held open three-quarters of an hour and the other several hours, while an acetylene torch was used to cut off parts of the steel at the points of interference.

Water and Sewers For a Small Town

By W. A. Hardenbergh

Town of fifteen hundred spends $100,0000 for water works, sewerage and sewage treatment. Trenching machines used and rapid progress made.

That a town of 1,500 inhabitants should spend more than $100,000 for construction of water works system and sewers may not be unique, but is interesting as showing what a town of this size can do. The town in question is Maiden, N. C., situated in the Piedmont section of the state, near the foothills of the Blue Ridge. It is an average place—no more prosperous than its neighbors. It contains three small cotton mills, only two of which are served by the new sewer system. As soon as the sewer and water mains have been laid, the streets will be paved, but not at the city's expense, for the state plans to build a hard-surface road through the main street of the town.

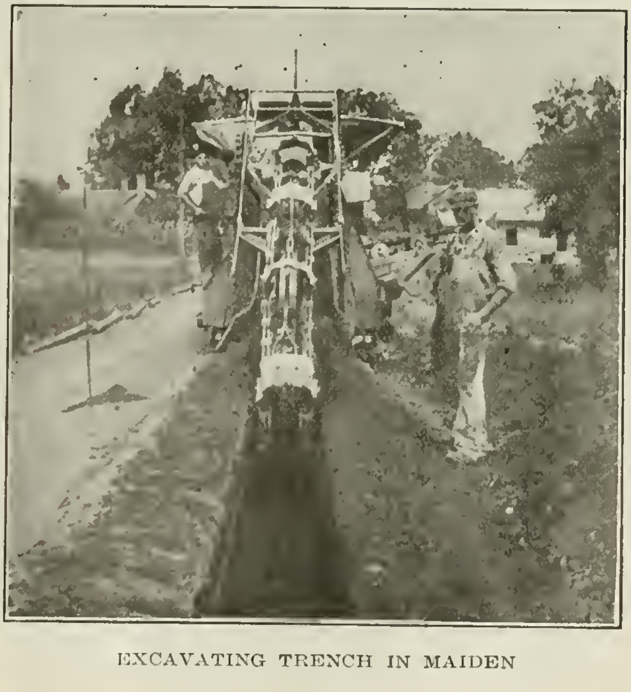
The means adopted for financing the work were not unusual, bonds being voted and sold to the contractor. The work is being pushed with unusual rapidity. Work was begun about the first of May, and the sewers were constructed in less than six weeks and the sewage treatment plants are now under construction, while the water mains were finished in July.

THE WATER SYSTEM

Water is secured from deep wells, the number of which will depend upon the amount of flow per well, which has not yet been determined. The water will be pumped electrically into mains of 1½ inches to 6 inches diameter, of which there will be about 24,000 feet. An elevated tank and tower will provide storage and pressure, the tank being elevated 76 feet and having a capacity of 100,000 gallons. It will give a pressure in the city of about 60 pounds. The cost of the system, including mains, pumps, well, tank, etc., will be about $50,000.

The pipe is laid and caulked entirely by hand. For backfilling, the contractor uses a plank with plow handles fastened thereto and dragged by a single team.

Outside of the rapidity of the work, the most interesting feature of the construction is the use of a ten-year-old Austin trenching machine for doing all the trenching. As high as 2,000 feet of trench 22 inches wide and 36 inches deep were excavated in a day. Outside of this, little attempt was made to use labor-saving machinery, partly because of the smallness of the job, and partly because labor is now fairly plentiful, cheap and efficient. The use of the trenching machine was rendered very desirable by the dry, hard, red clay which it was almost impossible to move by hand.



EXCAVATING TRENCH IN MAIDEN

SEWER SYSTEM

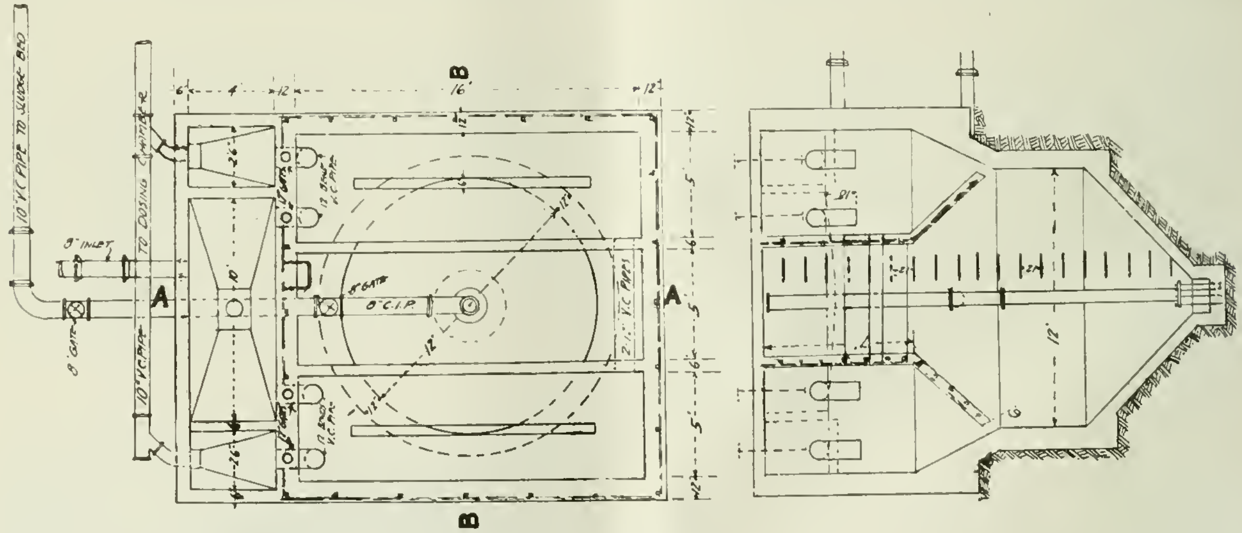
Two complete sewer systems were necessary, the town being located on a ridge. No storm water is carried and the sewage is treated in two separate plants. If all the town were sewered, three systems and three disposal plants would be needed, but it was finally decided to omit temporarily one small mill village. About four miles of 6-inch and 8-inch sewer have been laid. All ditching up to 12 feet in depth was done by the Austin trenching machine, but ditches exceeding this depth were finished by hand rather than change the adjustment of the trencher. The deepest trench was about 18 feet. Some rock was encountered and blasted. Where more than 12 feet deep, trenches were timbered. The clay stood while dry almost like rock but became like soft soap and treacherous when wet. The cost of the sewer systems and disposal plants will be about $54,000.

Of the disposal plants, one is about twice the size of the other. These are two-story sedimentation tanks. The smaller one is shown by the accompanying illustration. About 20 feet of excavation was necessary, through a layer of hard, red clay, a thinner layer of black, gravelly clay, followed by mud. A single row of 2 x 8 sheet piling, hand driven, served to retain the banks. A gasoline driven diaphragm pump kept the excavation dry. For mixing the concrete, an Austin half-bag mixer was used, using Lehigh Portland cement with a 1:2:4 mix.

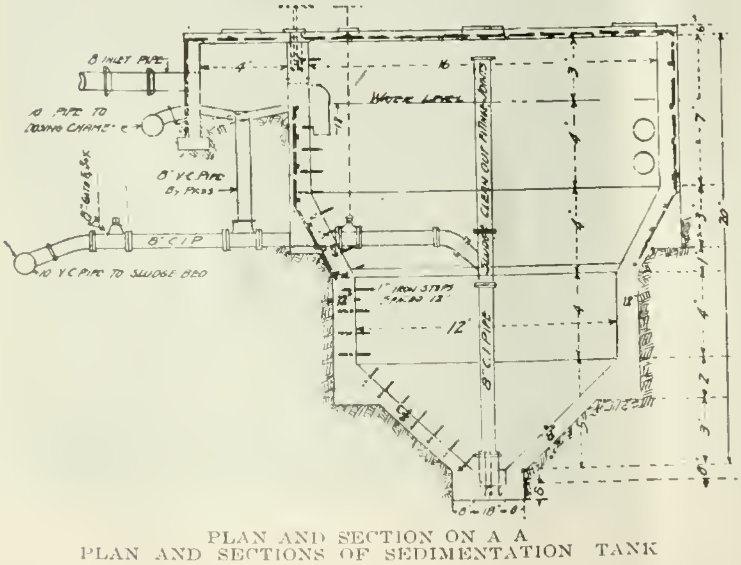
The tanks are peculiar in design in that the lower section is circular while the upper is rectangular. The warping of the circle into the square was a rather difficult piece of form construction. Another peculiarity is that the vent areas total one-third of that of the entire top of the tanks. The tanks are to be covered with a 6-inch concrete top, reinforced with half-inch bars, spaced 12 inches both ways in the large tank, and 12 inches transversely by 24 inches longitudinally in the small tank.

A small chamber is provided at the tank entrance which may be used as a grit chamber, for which a clean-out is provided. From this, the sewage may flow in either direction through either or both halves of the tank. At the end of the tanks opposite the entrance, are equalizing pipes connecting the two settling chambers. The settling chambers allow, with the present load, a retention period of slightly over three hours. Large sludge storage space is provided. The sludge bed provided for the larger tank is 25 feet wide and 50 feet long. A 3-foot concrete apron is placed at the outlet of the sludge pipe. The bed will consist of 2 feet of graded gravel drained by 6-inch pipe laterals laid 5 feet on centers, discharging into a 10-inch outlet drain which in turn discharges into a small creek. No secondary treatment is to be given the tank effluents for the present.

The work is being done by Boyd, Higgins & Goforth, of Charlotte, as contractors, C. D. Goforth at present acting as superintendent of construction. H. K. Setzer is resident engineer for the Carolina Engineering Co., of Wilmington, N. C., who are the consulting engineers for the work.



SECTION ON B B



PLAN AND SECTION ON A A
PLAN AND SECTIONS OF SEDIMENTATION TANK

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Handle and Erect Girder Spans Without Special Equipment—IV*

With locomotive cranes, derrick cars and wrecking cars.

Highway girders of any length may, when equipment is available, be very advantageously erected under most ordinary conditions by locomotive cranes, derrick cars and wrecking cars. One or two cranes or cars can handle the girders according to their position and weight.

Locomotive cranes of from 10 to 50 tons capacity with booms 25 to 75 feet long are found in the equipment of almost every large general contractor, and may therefore be often available for rental by smaller contractors in the neighborhood who do not possess them. Locomotive cranes are mounted on standard or broad-gauge railroad trucks, on traction wheels with wide flat surfaces, and on caterpillar traction. The first can, of course, be used only where railroad tracks are convenient, the second can be used on any smooth, level highway or on track planks properly laid in advance, even over soft ground, and cranes mounted on caterpillar traction can go almost anywhere, even up steep inclines and over soft or very rough ground, with or without roads.

Certain types of trenching and backfilling machines are substantially equivalent to locomotive cranes and may be used in the same way for bridge erection, but are usually of smaller capacity and therefore only able to handle spans of moderate weight. Generally, however, they are mounted on caterpillar traction and thus have a wide area of availability without the necessity for railroad tracks or the special preparation of roads.

Bridges over, or immediately adjacent to, railroad tracks very often can be erected by the derrick cars owned by the railroads and by the larger bridge contractors, or by the wrecking cars owned by most railroads, provided the owners are willing to rent them at the required time for a reasonable price. Both derrick cars and wrecking cars are built for extremely heavy service and often have capacities up to 100 tons or more. Derrick cars have longer booms than wrecking cars, generally from 30 to 65 feet, and are often provided with a pretty full erection equipment, including air compressor for pneumatic riveting, and are suitable for handling the longest and heaviest girders shipped, for which purpose they are especially designed. The wrecking cars have a much shorter reach, but can handle heavy loads.

All of the above-mentioned equipment serve essentially as moveable boom derricks, and when available are very rapid, convenient and efficient for loading, unloading, shifting and erection into position not only the girders, but also the floor beams, stringers and any other heavy members of the structure. They are also convenient for bringing heavy girders a considerable distance from the storage yards to the site, as is frequently necessary in short intervals when the tracks can be used between trains. In such cases, or for handling the girders at the site when they are very heavy two locomotive cranes or cars may be used, one at each end of the girder with the girder suspended between them on the center line of their

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*Part I.—Transportation to site and erecting by steam protrusion was published July 3.
Part II.—Erection by cribbing, jacking, rolling and skidding was published July 30.
Part III.—With fixed and moveable derricks was published August 6.

NEW EAST ROADWAY OF CHELSEA BRIDGE IN SERVICE. OLD WEST TRUSS NOT YET REMOVED

REMOVING OLD CENTER TRUSS OF CHELSEA BRIDGE

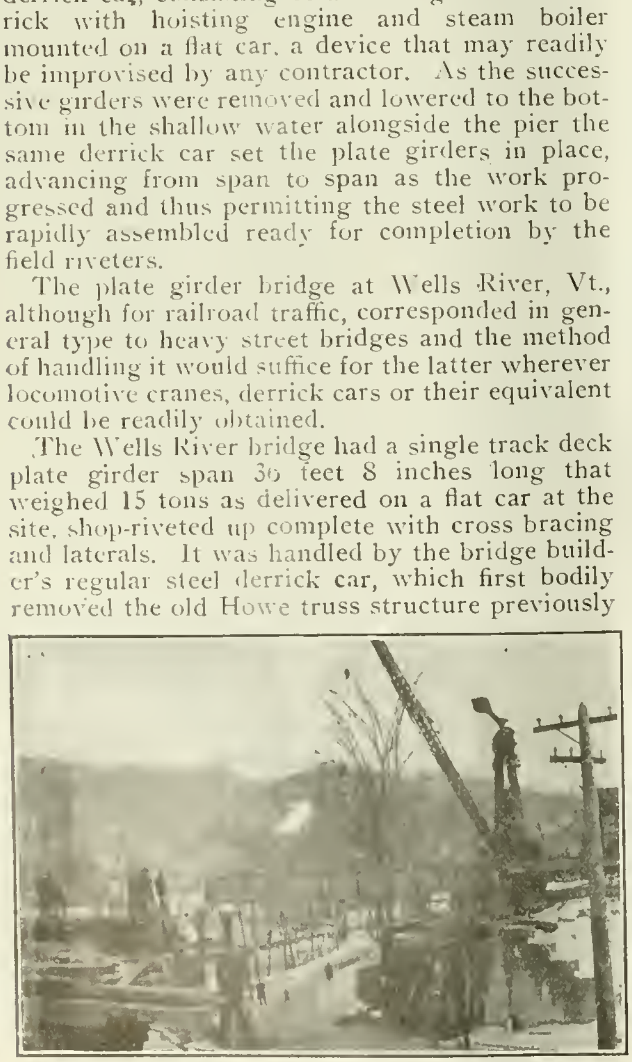
NEW SPAN DELIVERED AT OLD BRIDGE OVER WELLS RIVER, VT.

track or offset a short distance from it by swinging the booms, but great care must be taken in the latter case not to swing the girder far enough to threaten the stability of the cars or locomotive cranes, which are easily overturned with little warning when the moment becomes too great.

The bridge at Deal Lake, Asbury Park, N. J., consisted of fifteen 42-foot plate girder highway spans, each girder weighing a little less than 10 tons. They replaced old lattice girder spans on the same substructure that were removed by a derrick car, consisting of a stiff-leg wooden derrick with hoisting engine and steam boiler mounted on a flat car, a device that may readily be improvised by any contractor. As the successive girders were removed and lowered to the bottom in the shallow water alongside the pier the same derrick car set the plate girders in place, advancing from span to span as the work progressed and thus permitting the steel work to be rapidly assembled ready for completion by the field riveters.

The plate girder bridge at Wells River, Vt., although for railroad traffic, corresponded in general type to heavy street bridges and the method of handling it would suffice for the latter wherever locomotive cranes, derrick cars or their equivalent could be readily obtained.

The Wells River bridge had a single track deck plate girder span 36 feet 8 inches long that weighed 15 tons as delivered on a flat car at the site, shop-riveted up complete with cross bracing and laterals. It was handled by the bridge builder's regular steel derrick car, which first bodily removed the old Howe truss structure previously carrying the railroad track across the highway. Having lifted the trusses and floor system entire by means of bridles attached to the lower chords at panel points, the car removed it a short distance away from the crossing, deposited the old superstructure on the ground, returned to the flat car on which the new plate girder span was received, unloaded it, carried it to the site and swung it to position by practically continuous operations, thus completing the replacement of the superstructure with a minimum of delay or hand labor.



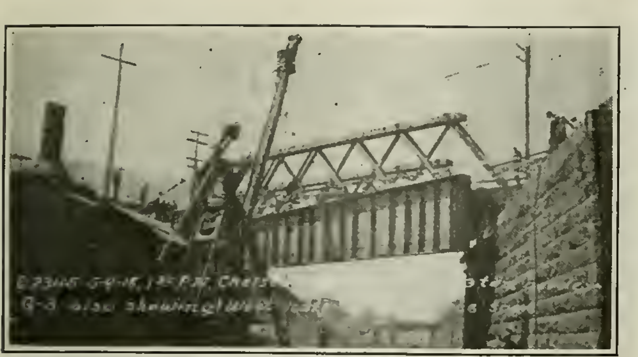
ERECTING PLATE GIRDER SPAN COMPLETE AT WELLS RIVER, VT.

The highway bridge over the railroad tracks at Chelsea, Mass., was originally constructed with three wooden Howe trusses that were replaced without interrupting traffic by a 130-ton steel span with five main girders from about 76 to 84 feet in length. The replacement of the old superstructure by the new one on the old substructure was effected without interrupting the railroad or highway traffic by a heavy standard derrick car belonging to the contractors, the American Bridge Co., which was operated at low level on the regular railroad tracks at intervals between trains.

Traffic being diverted to the west half of the bridge the floor of the east half was removed, the derrick car lifted the old truss from the substructure and carried it away, then returning erected the new center girder and the two side girders in their proper positions, assembled the floor beams and bracing to them and the floor was laid, permitting the traffic to be diverted from the west to the east side of the bridge, after which the remainder of the old floor was removed, the derrick car took down the old center and west trusses and erected the remaining two plate girders, the floor beams, and the remaining bracing, enabling the west half of the floor to be laid and completing the new superstructure.

In handling heavy girders with locomotive cranes, derrick cars and other equipment of the same type it must always be remembered that the stability of the derrick is of vital importance and that it varies directly with the height of the boom, being maximum when the latter is topped up highest, and the least when it is extended horizontal. When the derrick is mounted on a turntable, as in the case of locomotive cranes, the angle the boom makes with the track is immaterial, because the counterweight moves with it, but in the derrick car and the other types of equipment, the

DERRICK CAR TRANSPORTING OLD SPAN OF WELLS RIVER BRIDGE TO STOCK YARD



ERECTING 23-TON PLATE GIRDER FROM LOW LEVEL TRACKS

counterweight, usually consisting of the whole car, remains stationary and its stability is least when the boom is at right angles to the track. In nearly all cases the stability can be increased by anchoring the truck or car to the track with clamps, chains or other devices and in special cases extra heavy loads can be handled in the given position by guying or bracing the car or the frame from which the boom is operating.

Eliminating Prohibitory Wages in Dallas

Exorbitant demands of bricklayers, plasterers and plumbers have necessitated a stoppage of building construction. The city subjected to the highest scales reported from many high-priced cities.

For the purpose of bringing about a reduction in wages being paid bricklayers, plasterers and plumbers in Dallas, contracting firms and individuals who have buildings under construction or contemplated were requested by the Chamber of Commerce to cease operations until such time as a reasonable adjustment in the wages of the three crafts mentioned is effected.

A resolution setting forth the views of the chamber was adopted at a meeting which was called at the request of persons engaged in building and also in compliance with the wishes of the General Contractors' Association of Dallas. About 100 business men attended.

According to reports from eighteen principal cities in the country relative to wage scales, the scale for bricklayers is higher in Dallas than in any other city mentioned except Fort Worth and that in the other two crafts the scale is higher in Dallas.

The plumbers have stated individually to their various employers that they would be glad to accept the requested cut of $1 a day, but at their regular meeting on Monday, August 1, the business agent did not allow the question of the reduction to be brought up on the floor.

The present rate of $12 for bricklayers and plasterers and $11 for plumbers has discouraged building and many contracts await assurance of lower wages. During the war the plumbers' pay was increased from $6 to $11 a day and a contract made with the union to maintain it until August 14, 1922, modified by a verbal agreement, now repudiated by the union, to make reductions when conditions approached normal.

At the meeting of contractors all expressed the opinion that the bricklayers' wage of $12 a day is disproportionate to all other trades and other cities and should be reduced to $10 per day or less.

The action of the Dallas Chamber of Commerce is commendable. It is high time that the long-suffering builders and constructors who represent the second largest interest in this country, should be permitted to resume their activities on which the prosperity and progress of the nation depends more than on any other factor, with the possible exception of direct food production.

In the war emergency construction interests were very largely declared non-essential and heavily discriminated against; wherever they were permitted a measure of activity they were saddled with huge handicaps of totally unnecessary and unjustified excess costs of wages initiated and fostered for political purposes, that have proved an almost overwhelming handicap and are still keeping the whole country far behind in the international race for readjustment.

While the whole country has suffered from the waste and derangement of war and the extravagance of post-war conditions, only the profiteers and laborers have escaped its heavy burdens and have actually profited by the adverse conditions and reaped a huge selfish harvest from the necessities and misfortunes of their neighbors.

Now that the whole country has, in effect, gone into liquidation, its merchants, financiers, investors and industries have accepted their losses and reduced prices to a more reasonable level, labor alone insolently demands not only its outrageous extreme price, but in many cases calls for still greater increases, retains a considerable degree of the inefficiency encouraged by war conditions, and in many cases deliberately soldiers on the job in order to prolong the small amount of inevitable work and thus add yet more to the unit costs which, in many cases, are still three or four times as great as the pre-war rates.

It is plain that prosperity cannot be generally attained until wages take their fair share of reduction and labor becomes reliable and efficient. Men or unions that are demanding steep prices when their necessities are reduced at the price of great loss and business depression should be summarily dealt with and if it needs a long breadline and stern measures to convince them, the sooner they are attained the better. It is to be sincerely hoped that in every place where wages are disproportionate and where labor is not amenable to reasonable and honest arrangement, measures will be taken similar to those in Dallas, and all construction stopped short until a satisfactory basis can be established and maintained.

A 90-ton Marion steam shovel in a quarry at Carlton, Cal., has special safety equipment. The boom gears are enclosed by removable sheet iron guards; stairways on each side of the boom give access to all parts of it when in operation, and, like the runways and openings on the sides of the cab, are protected by handrails, so that all the fast-moving and hazardous machinery is inaccessible to personal contact. Such precautions not only reduce danger of accidents, but preserve the machine and expedite and increase its work.

Recent Legal Decisions

ESTOPPEL BY DELAY TO OBJECT TO PAVING ASSESSMENT

In an action to have a lien for a paving assessment adjudged invalid, it was held, Johnston v. City of Hartford (Conn.), 113 Atl. 273, that it was the plaintiffs' duty, if they had intended to object to the improvements, to use all means in their power to prevent the making or execution of the contract for paving. This they did not do. They stood by in silence and acquiescence during a year, and permitted the contract to be made, the work to be completed, the assessment laid, and the city's portion of it to be paid, meanwhile retaining all the benefits of the improvement. It was held that the plaintiffs, by their conduct, had estopped themselves from attacking the validity of the assessment and lien.

ORDINANCE AGAINST INCREASING SIZE OF WOODEN BUILDINGS IN CITY HELD REASONABLE

The Maine Supreme Judicial Court holds, City of Lewiston v. Grant, 113 Atl. 181, that an ordinance of the city of Lewiston, adopted pursuant to statutory power, and providing that no wooden building standing on any lot within prescribed limits shall be repaired or altered so as to increase its present height or size, is not unreasonable in its purpose to diminish fire hazard, is clearly within the police powers of a city or town, and is not in conflict with any constitutional provision. "The added height or size of wooden buildings in a congested portion of any city or town may have a material effect upon the danger of extensive conflagrations and the hazard to surrounding property."

CONSTRUCTION OF GUARANTY AS TO MAINTENANCE BY CONTRACTOR IN PAVING CONTRACT

A city sued an asphalt company and its bonding company for damages arising out of a paving contract, in which the contractor guaranteed: "That the pavement laid shall be of such material and with such workmanship that the pavement shall be and remain in good repair and free from all settlements, defects and damages due to the use of defective material and workmanship or the proper use of the street as a roadway or the action of the elements for the full term of ten years," with an additional provision as to the repair of disintegration. This guaranty was substantially repeated in the bond. On appeal from a judgment for the city, the defendants' counsel said that the only question presented was the meaning of the words "or the proper use of the street as a roadway or the action of the elements.' They argued that the contract and bond simply insured the character of the material and workmanship furnished by the company, and that as the trial court found in their favor on these matters they were entitled to prevail. The Kansas Supreme Court holds, City of Leavenworth v. Green River Asphalt Co., 196 Pac. 1091, on the authority of Kansas City v. Hanson, 60 Kan. 833, 58 Pac. 474, that the contract and bond guaranteed the pavement for ten years only as to the character and workmanship furnished by the contractor. The fact that certain repairs were made by the contractors some nine years after the completion of the work did not estop them from maintaining this defense. Judgment for the plaintiff was therefore reversed, with directions to enter judgment for the defendants.

SUIT TO ENJOIN SEWER ASSESSMENT BARRED BY DELAY

The Oklahoma Supreme Court holds, Woodward v. City of Tulsa, 196 Pac. 683, that under section 471, Rev. Laws 1910, an action to enjoin assessments levied to pay certain tax warrants issued for the construction of sewers in the city of Tulsa and to cancel said tax warrants on the ground that the estimates for the work were fraudulently made by the contractor and the city officials, where the city acquired jurisdiction by proper proceedings to construct the sewers, cannot be maintained after the expiration of 60 days from the passage of the ordinance making the final assessment, the period within which the statute provides suit to set aside an assessment must be brought. The estimation of the items making up the different kinds of work done in excavating the sewer, if done incorrectly and fraudulently, was an irregularity and did not go to the jurisdiction of the city in levying the assessment or in issuing the warrants or certificates, and to have been taken advantage of must have been by action brought prior to the expiration of the 60-day period provided in the statute.

TIME FOR PROTEST AS TO MATERIAL USED IN WORK—EVIDENCE AS TO SUFFICIENCY OF MATERIAL

Where road work was inspected from time to time while it was in progress by the county commissioner in whose district the road was situated and who was by law ex-officio road commissioner therein, and no objection was made by him to the character of the material used in the construction, the Washington Supreme Court holds, Brown v. Benton County, 197 Pac. 7, that if materials were to be protested good faith required that the protest be made at the time of the inspection.

The evidence in the case, which was against the county for balance due on the contract, was held by no means convincing that the material used for binding purposes was defective or unsatisfactory in the sense that it would under no circumstances serve the purpose for which it was intended. Both the contractor and the engineer testified that it was as good as any that could be obtained in the vicinity of the road, and fully equal to that which the county afterwards caused to be placed thereon. They stated that it did not pack firmly under traffic without sufficient moisture; and that the county secured a better result because they applied it at a more favorable season. Judgment for the plaintiff was affirmed.

NEWS OF THE SOCIETIES

Aug. 23-25—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS Annual meeting. Detroit, Mich. Secretary, Emmet P. Griffin. Superintendent of Park, East St. Louis, Ill.

August 29-30—INDIANA BUILDING TRADES COUNCIL, Hammond, Ind. Henry Gabler, Secretary, 436 Sumner st., Hammond, Ind.

Aug. 30-Sept. 1—MICHIGAN STATE GOOD ROADS ASSOCIATION. Annual meeting. Flint, Mich.

Sept. 6-10—INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Colorado Springs, Colo. Secretary, C. R. George, Houston, Texas.

Sept. 12-26 — AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS. Wilkes-barre, Pa.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 19-21—ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA. Chicago, Ill. Secretary, P. J. McAndrews, C. & N. W. Ry., Sterling, Ill.

September 19-24 — ASSOCIATION OF IRON AND STEEL ENGINEERS, La Salle Hotel, Chicago, Ill.

Sept. 26-30—ILLUMINATING ENGINEERING SOCIETY. Rochester, N. Y., Illuminating Engineering Society, Chicago Section, Chicago with National.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventth annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 5-7—SOCIETY OF INDUSTRIAL ENGINEERS. National convention. Springfield, Mass.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. **New York City.**

AMERICAN ENGINEERING COUNCIL

The next meeting of the executive board of the American Engineering Council of the Federated American Engineering Societies will be held at the Cosmos Club, Washington, on September 30. The most important business coming before this meeting will be the election of a president to succeed Herbert Hoover, who resigned after he became Secretary of Commerce. Special attention will be given the plans for the Engineering Assembly, extension of Employment Service, question of licensing and registration of engineers.

The engineering assembly committee has been appointed with A. P. Davis as chairman. Present plans are to make this assembly a three days' session, starting between the middle and latter part of January. In general, one day will be given to special meetings of the executive boards of member organizations and committees of the American Engineering Council. One day will be given to the sessions of the American Engineering Council and at least one day will be given to the discussion of some special topics such as elimination of waste, licensing of engineers, the national department of public works or some other subject of equal importance to the engineering profession.

On the question of licensing of engineers it is contemplated that council's licensing committee will be able to submit a complete report to the board. Licensing had become such a very important subject with engineers that the executive board instructed its committee to proceed with hearings on this subject as a basis for further reviewing and changing the model licensing law. It is contemplated that the Committee on Classification of Engineers will report its recommendations to the council at the next meeting.

THE CONNECTICUT SOCIETY OF CIVIL ENGINEERS

The annual summer outing was held August 9, at Double Beach, Conn., on Long Island Sound, about 9 miles from New Haven, whence the members and guests journeyed by automobiles. There was a baseball game between Hartford and New Haven teams, swimming and running races, and other sports, and a shore dinner was served. A short business meeting was held at which new members were elected.

PERSONALS

Briggs, B. A., is now with the Colorado State Highway Department.

Morse, W. C., has opened offices in Seattle, Wash., where he will engage in general engineering-contracting work.

Shaw, Arthur M., will superintend the design and construction of a complete sanitary sewer in San Pedro, Sula, Honduras, C. A.

Bogard, Noah, of Washington, Ind., died July 18 of heart trouble at Olney, Ill.

Smith, Herschel C., has been appointed assistant professor of highway engineering and highway transport at the University of Michigan.

McGrath, J. K., is now division engineer with the West Virginia State Highway Department.

Briggs, B. A., is now connected with the Colorado State Highway Department.

Stringfellow is a new member of the Alabama State Highway Commission.

Limerich, R. C., has been appointed state highway engineer of Arkansas.

Middleton, Ellis G., is now with the West Virginia State Highway Department

Pridgen, J. B., has been appointed engineer in charge of construction by the North Carolina State Highway Commission.

McCluskey, Jr., W. J., has been appointed assistant division engineer by the West Virginia State Highway Department.

Spooner, W. C., has been appointed superintendent of highways of Duval county, Fla.

Ross, F. E., has been appointed city engineer of Jefferson City, Mo.

Dambach, W. N., is now with the Carlem Engineering Co., Pittsburgh, Pa., in the capacity of vice-president.

Sims, Frank F., has opened offices for the practice of industrial engineering at 1306 L. C. Smith building, Seattle, Wash.

Downie, R. W., has been appointed tester of building materials for the Welland Ship Canal at Merritton, Ont.

Crocker, Herbert S., has reopened his office in Denver, Colo.

W. J. Young has been made chief engineer of the Standard Lime & Stone Co., and of the Washington Lime Co., of Baltimore, Md.

Reid & Milford have opened a new office at Fourth street and Western avenue, Los Angeles, Cal.

Edgar T. Wheeler now has his offices at 402 Los Angeles Railway building, Los Angeles, Cal.

Gillespie, Richard H., died at White Lake, N. Y., on July 15.

Knodel, E. C., died July 15 in Atlanta, Ga.

Andrews, John S., of Seattle, Wash., died July 17 at the age of fifty.

Oliveras, Adolpho, died in Santa Monica, Cal., at the age of sixty-six years, on July 3.

Hanson, Joseph, died in Tacoma, Wash., recently.

INDUSTRIAL NOTES

The Bingen Brick Manufacturing Co., Bethlehem, Pa., has been incorporated with Mahlon Ritter at its head.

G. J. Fink is now on the technical staff of the chemical department of the National Lime Association, Washington, D. C.

The Allied Machinery Co. of America, 51 Chambers street, New York City, has been appointed foreign representative for the Universal Crane Co., Cleveland, Ohio.

The Elcon Engineering Co. has opened offices in Columbus, Ohio, and will engage in general contracting and engineering, specializing in elevating and conveying equipment.

The firm of Batchelder & Scales has been organized at 35 West 27th street, Indianapolis, Ind., for the purpose of conducting a general architectural and structural engineering business.

Norman J. Warren has been appointed general manager for the Dominion Bridge Co., Ltd., and will have his headquarters at Montreal.

E. W. Verity, Jr., has been appointed construction manager with headquarters in New York City, for Admiral & Co. Carl H. Sanbord was made New England representative with headquarters in Boston, Mass.

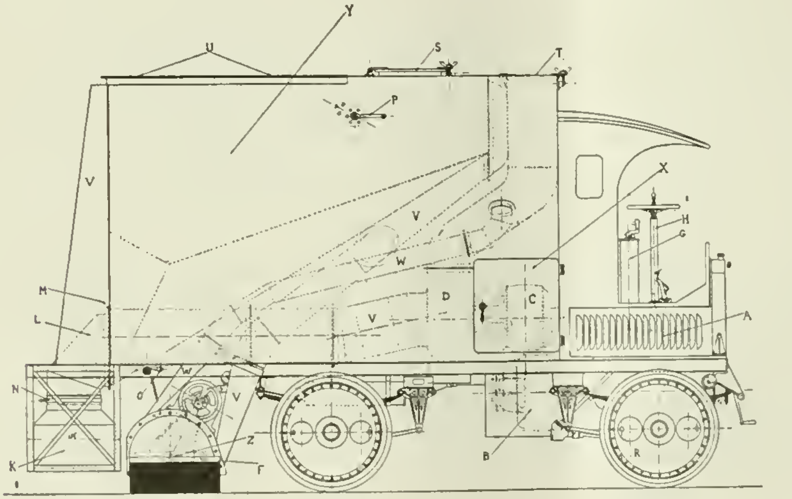
New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

ELECTRIC VACUUM STREET SWEEPER

The Ohio Municipal Equipment Co., after several years' experimenting, has developed a machine that is now being offered to municipalities in two standard sizes, viz., of 8-foot 6-inch and 4-foot 6-inch sweeping widths.

All operations are by electricity, which is generated on the machine, this including power to propel the machine, operate the exhausters and manipulate the revolving brush. There is a separately controlled motor for each service, so that the suction at the point of pick-up and pressure at the back of the brush, which are created by the exhauster, can be regulated to suit the condition of the street, as can also the speed of revolution of the brush.



ELECTRICALLY OPERATED VACUUM STREET SWEEPER

The points of advantage claimed for this sweeper are:

It works rapidly and without dust.

Street sprinkling and flushing are entirely eliminated.

No dirt or refuse is handled by the exhauster.

The machine does not dump dirt on the streets or visit the dump.

It sweeps at 3 to 5 miles an hour and travels 12 to 15 miles to and from the working area.

It is quiet in operation, handsome in appearance, sanitary and hygienic.

The streets of Columbus, O., are being swept with it every day and demonstrations have been made in neighboring towns.

Operating Costs—Based on a $14,000 list price of an 8-foot 6-inch sweeper, machine operating 5 miles per hour, 16 hours a day, and gasoline at 31 cents per gallon, the costs are figured as follows:

1 Driver at $4.50 per day of 8 hours	$4.50
2 Helpers at $3.50 per day of 8 hours	7.00
Gas consumption, based on 5 mi. per gal. of gasoline at 31 cents per gallon	2.40
Oil based on consumption of 400 mi. per gal. of oil	.10
Tires, 2c. per mile	.80
Repairs, 2c. per mile	.80
Interest on list price of $14,000 at 5%, assuming 300 working days of 16 hours per day; for 8 days	1.16
Depreciation, 10% on $14,000 assuming 300 working days of 16 hours	2.33
Brush renewals, assuming 1 fibre brush lasts 96 hours—12 days of 8 hours	2.00
Cost per 8 hours work, total	$21.17

Area swept in 8 hours, assuming 5 miles per hour and 8 ft. 6 in. sweeping width, area cleaned in 8 hours = approximately 200,000 sq. yds.

Cost per 1,000 sq. yds. cleaned

$$= \frac{200,000}{1,000} = 200 \text{ costing } \$21.17$$

10 2/3 c. per 1,000 sq. yds. cleaned.

Description of Machine—Chassis, built under license of Church Balance Gear Co. Electric power plant comprises internal combustion motor direct coupled to specially designed dynamo, carried at front end of chassis. The propelling motors are built into the disc steel wheels and thus totally protected from dust and water. The controller is mounted in a position convenient for the driver and all control meters are in his view. All parts of driving mechanism and controls are accessible for adjustment and repairs.

The brush and pick-up mechanism are placed behind the rear wheels. The brush can be removed and replaced without dismantling any other units of the chassis.

All the street refuse is collected in the large separator and then gravitates to the removeable containers at the rear of the machine, which are removed when full and replaced with empty ones without stopping the machine.

The accompanying diagram of the machine shows clearly its construction and operation.

Description of Parts

A.	Internal combustion gasoline motor generates power for all motors.
B.	Electric generator.
C.	Electric motor driving exhauster.
D.	Exhauster.
E.	Electric motor driving brush.
F.	Vertical revolving brush.
G.	Electric controller.
H.	Steering wheel pillar.
J.	Flexible flange around brush casing.
K.	Removable container.
L.	Refuse outlet pipe.
M.	Outlet pipe valve.
N.	Clamping device for containers.
O.	Handle for brush lifting mechanism.
P.	Handle for screen agitator.
R.	Motor equipped driving wheels.
S.	Man hole to separator chamber.
T.	Inspection cover for outlet from exhauster screen.
U.	Flange of removable screen.
V.	Suction and intake pipes to separator and exhauster.
W.	Blow pipes to brush casing.
X.	Door to spare container receptacle.
Y.	Main separator.
Z.	Main revolving brush.

The Orangeville Brick & Shale Products Co., Orangeville, Ohio, has been incorporated for the purpose of brick manufacture.

Clarence V. Brown has been appointed receiver of the Universal Utilities Corporation at Alpena, Mich.

J. S. Molloy is the mill manager of the Centerville Gypsum Co., Centerville, Iowa

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Fred M. Randall has been elected president of the National Cement Co., of Detroit, Mich.

F. E. L. Whitesell has been appointed New England representative of the Railway & Industrial Engineering Co.

Wills, Bill & Co. will carry on the business of Wills, Ludwick & Co., 1700 Sansom street, Philadelphia, Pa.

William J. Reintjes has his office at 1517 Commerce building, Kansas City, Mo.

The Badger Concrete Mixer Co. will have a new factory at Winthrop Harbor, Ill., just north of Chicago.

The Barrett Company are now occupying their new offices at 40 Rector street, New York City.

The Heltzel Steel Form & Iron Company, of Warren, Ohio, has acquired the services of J. D. Ackenheil, formerly connected with the Portland Cement Association as field engineer, Pittsburgh district.

Mr. Ackenheil has had considerable experience along the line of road building in promotional and constructive capacity, having had supervising charge of a number of important highways. The subject of steel forms has been one of his studies from a constructive viewpoint, during his four years' service with the association, and he is, therefore, well fitted to advise and confer with contractors and engineers as to forms and other details of highway construction.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 AUGUST 27, 1921 No. 9

Constructing the Wanaque Dam

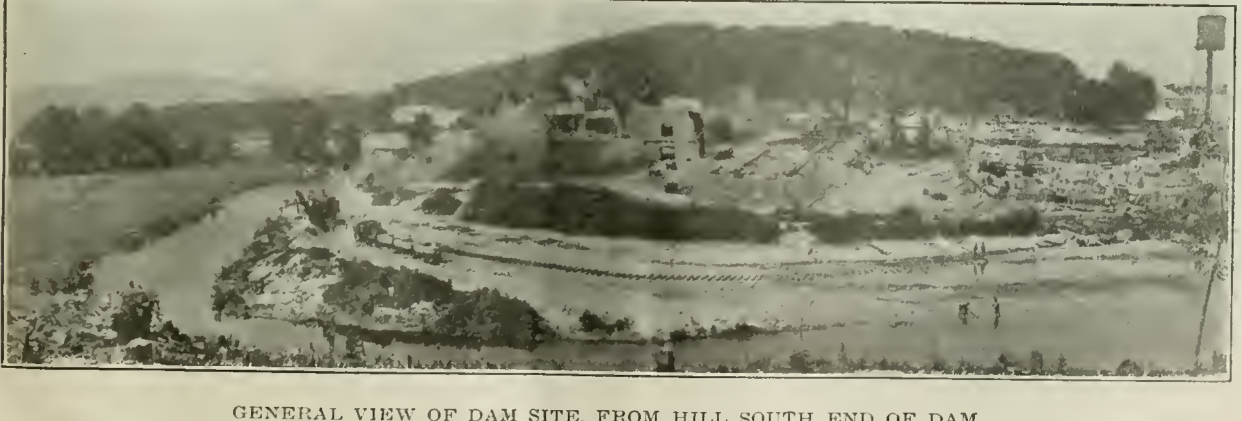
The North Jersey District Water Supply Commission is building, near the northern end of New Jersey, an earthen dam with concrete core wall about a thousand feet long and 170 feet maximum height. Spliced steel sheet piles eighty feet long are being driven through compact gravel. The plant is unusually complete.

The general plan of the Wanaque dam, which is being built by the North Jersey District Water Supply Commission for furnishing water to Newark and other New Jersey communities, was described in our issue of April 17, 1920, and the contract made with W. H. Gahagan, Inc., for constructing the first part of this work was described in the issue of December 4. The contract is a form of cost plus the contractors' commission, increasing as the cost decreases below a fixed total or base price, which is about $1,125,000. The present contract is chiefly for the core or cut-off wall, which is being built across the valley in advance of the construction of the earthen embankment, of which the dam will be composed.

This concrete wall will be carried down to bedrock across the valley with depths ranging up to about 100 feet, or a total height of 170 feet. The total length of the core wall is between 900 feet and 1,000 feet. The wall will be 12 feet thick up to the surface of the ground, above which there will be a batter of 20 on 1 on each face. Along the line of the core wall, the ground surface has an elevation of approximately 225 feet above mean sea level. At the north end, the last 100 feet rise sharply to the finished grade of the dam. On the south end, the wall ends in a gate house on the side of the steep hill. The Wanaque river crosses the line of the core wall near its south end. The wall will be completed nearly to the river, the stream later being diverted into another channel and the core wall completed.

THE CORE WALL TRENCH

Before beginning the excavation of the core wall trench proper, a trench with sides sloping one to one and a bottom width of 60 feet was excavated by steam shovel along the line of the core wall, its bottom being brought to a uniform elevation of 212, or 13 feet below the general ground level. Along the center of this channel is dug the core wall trench 20 feet wide. The construction of this trench is at present the most interesting feature. Steel sheet piling is being driven along each side of the trench down to solid



GENERAL VIEW OF DAM SITE, FROM HILL SOUTH END OF DAM.
Camera is on centre line of core wall. Wanaque river in foreground. At left background, track (on embankment) leading to gravel pit. In foreground, paper sludge being removed by steam shovel and dump cars. At extreme right, remains of paper mill cellar, and old water tank, put to use by contractor.

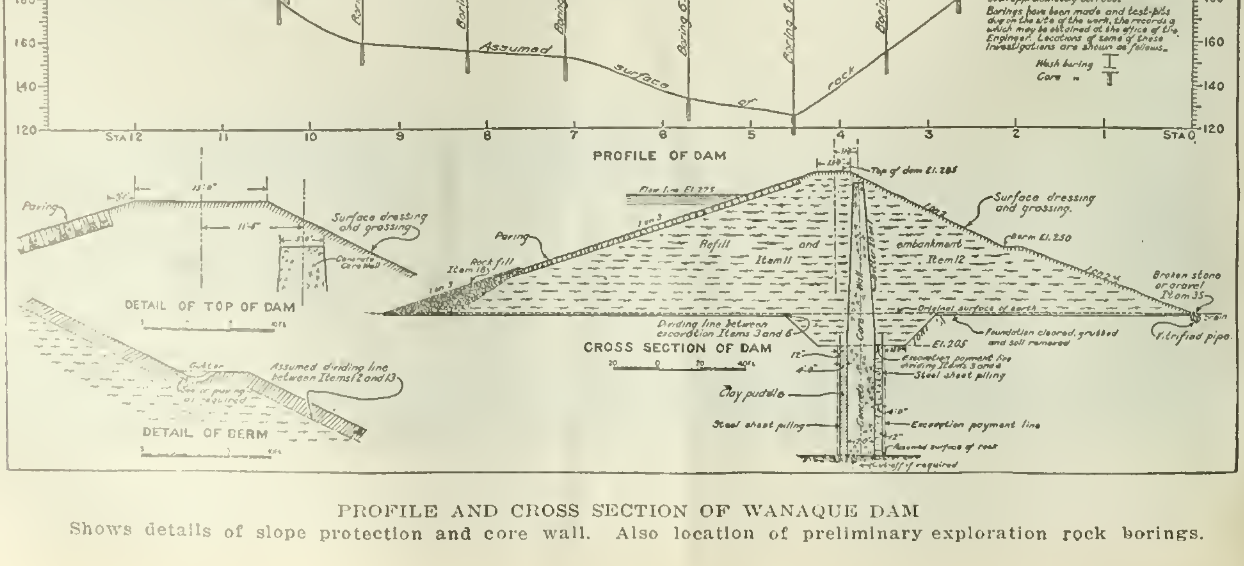
rock, the excavation between the lines of sheet piling following along behind but practically no excavation has been performed as sufficient sheeting on both sides of that point has been driven to refusal on bedrock. The most noteworthy feature of this is the depth to which the sheeting is being driven, a maximum of 80 feet of continuous steel sheet pile having been driven at the deepest portion of the rock valley.

The site of the reservoir, and the valley for a considerable distance below, was formerly the bottom of a lake and was filled in with sedimentary deposits. The site of the dam is near the upper end of this lake and the deposits here are largely of gravel and coarse sand, with a little fine sand near the surface but no clay except talus washings from the hills, the clay having all been deposited further down the valley. The gravel runs from very fine material up to stones of 2 to 3 inches and occasionally larger. This makes a very solid material and difficult for driving sheet piling.

The sheet piling used is Lackawanna, 35 pounds to the square foot, and in various lengths from 20 feet up to 50 feet. A depth of 100 feet was reached at a distance of about 250 feet from the north end and the depth is now gradually decreasing. In securing the different depths, piles varying from 20 to 50 feet in length are used, and are spliced for depths exceeding 50 feet. Although the piles are protected by a driving cap, there is more or less battering of the head owing partly to the hard driving required, and in making the splice the battered end where necessary is cut off by means of an oxyacetylene torch. Care is taken to obtain a square end in order that the splice may obtain perfect contact between the two lengths of piling. It is proposed to endeavor to draw the piles in order to salvage them and the splice is therefore made stronger than would otherwise be the case. Each pile has three holes bored on each side of the pile or twelve holes at a joint. The splice is made by placing a steel channel on one side of the pile and a steel plate on the opposite side and bolting the two together through the holes already provided in the sheet piles. This provides a very strong and stiff splice.

The piles are driven by two 5-ton Vulcan steam hammers, one working on each side of the trench. The hammer is supported by a driver with its guides extended so that the sheave is 90 feet above the ground surface. The pile driver is mounted on a platform which is moved backward and forward along the trench by its own power. Piles are driven in sections of about 50 feet. In starting each section, a frame of heavy timber is moved forward, this frame standing about 25 feet high, 50 feet long and 20 feet wide, this being the width of the trench between sheet piling. By means of the pile driver, the sheet piles are then assembled and interlocked against the frame where they are held in position independent of the pile driver. The pile driver then moves backward and forward, driving each of several piles a foot or two, one after the other, in order that, within certain limits of variation, all the piles in a set shall move down together. The chief object of this is to keep the alignment of the piles underground as nearly straight as possible.

As an indication of the difficulty of the driving, in some cases 60 blows of the 5-ton Vulcan ham-


GATE HOUSE
WANAQUE R.
Top of dam El. 285
Top of core wall
Upper limit of payment for steel sheet piling.
Excavation payment line dividing Items 3 and 6
Original surface
El. 210
El. 205
Boring 3A
Boring 2A
Boring 4. L55'
Boring 1A. R20'
Boring 7. L35'
Boring 6. R10'
Boring 6A. R15'
Boring 3. R
Boring 7A
Assumed surface of rock
Ledge rock is shown at depth which is regarded as probable, but the Commission does not guarantee that this depth is even approximately correct.
Borings have been made and test-pits dug on the site of the work, the records of which may be obtained at the office of the Engineer. Locations of some of these investigations are shown as follows.
Wash boring
Core "
280
260
240
220
200
180
160
140
120
STA 12
11
10
9
8
7
6
5
4
3
2
1
STA 0
PROFILE OF DAM
Paving
Surface dressing and grassing
Concrete Core Wall
DETAIL OF TOP OF DAM
Gutter
Assumed dividing line between Items 12 and 13
DETAIL OF BERM
Top of dam El. 285
Flow line El. 275
1 on 3
Paving
Rock fill Item 18
Refill and embankment
Item 11
Item 12
Surface dressing and grassing.
Berm El. 250
Broken stone or gravel Item 35
Drain
Vitrified pipe.
Original surface of earth
Foundation cleared, grubbed and soil removed
Dividing line between excavation Items 3 and 6
CROSS SECTION OF DAM
El. 205
Excavation payment line dividing Items 3 and 6
Steel sheet piling
Clay puddle
Steel sheet piling
Excavation payment line
Assumed surface of rock
Cut-off if required
Concrete Core Wall

PROFILE AND CROSS SECTION OF WANAQUE DAM

Shows details of slope protection and core wall. Also location of preliminary exploration rock borings.

mer are required to drive a pile one inch. This is exceptional, however, 3 or 4 blows ordinarily being sufficient to drive one inch, while in some soft spots the pile will go an inch or two inches at a single blow. The hammers operate at a rate of almost exactly 60 blows per minute.

A trial was made of the use of the water jet to aid in driving the sheet piling, but owing to the nature of the material it was found that there was only an occasional slight benefit derived, which showed that the use of the jet would be no economy and could not be relied upon except as a slight aid to the use of the heavy hammer.

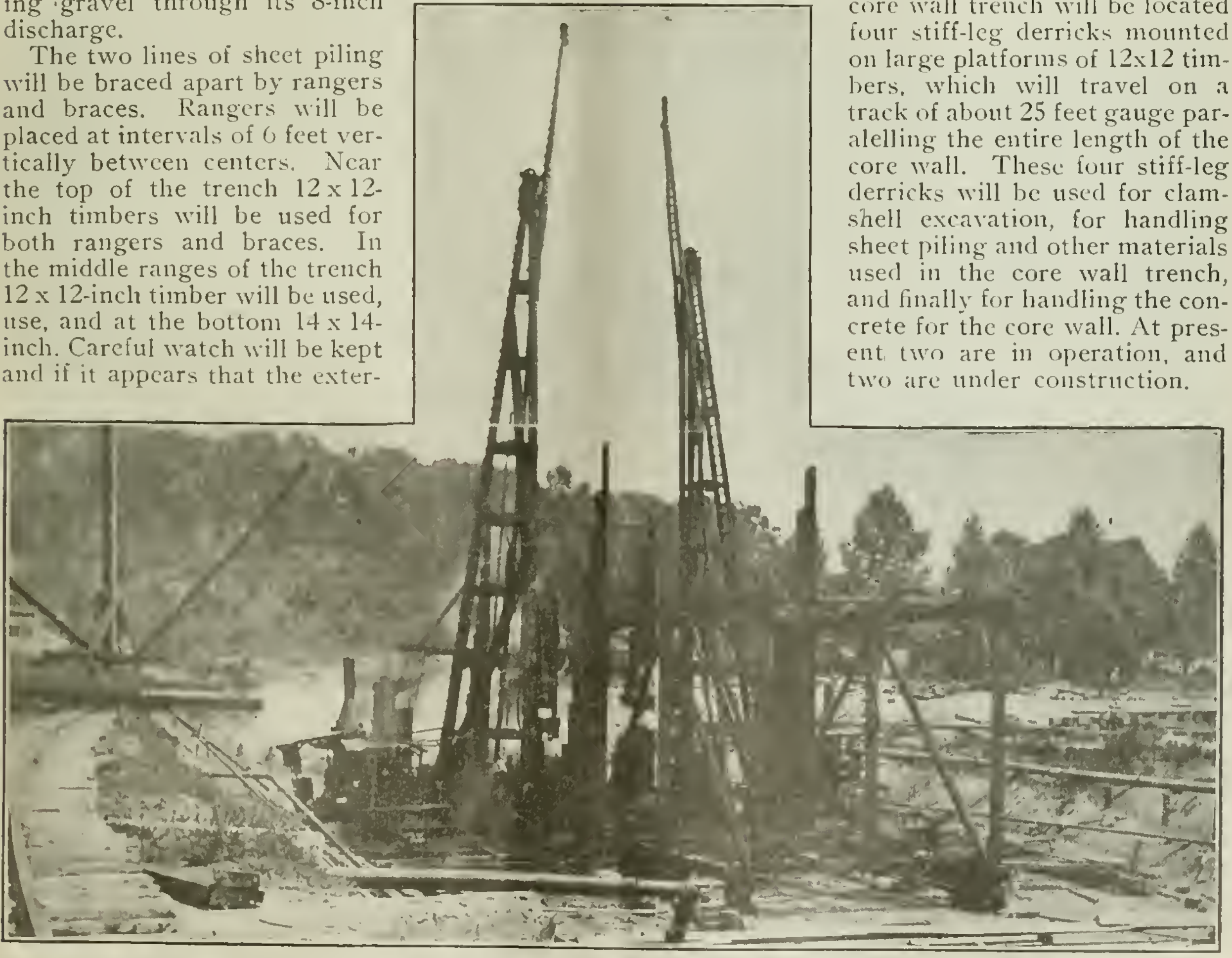
As the piles are driven and the frame and drivers move ahead, the gravel between the two rows of piling is removed with a clam-shell bucket operated by a stiff-leg derrick. Owing to the compact gravel formation in part of the trench, it is difficult for the clam-shell to penetrate and obtain more than one-quarter load at a time. In addition to this, the bottom of the trench has been carried 4 or 5 feet below ground water level and on July 23 a dredge pump was installed with the idea of dredging the remaining depth of the trench and depositing the gravel on the downstream side of the dam. At the time of the visit of the writer to the work, July 26, the pump was just going into action and was delivering gravel through its 8-inch discharge.

The two lines of sheet piling will be braced apart by rangers and braces. Rangers will be placed at intervals of 6 feet vertically between centers. Near the top of the trench 12 x 12-inch timbers will be used for both rangers and braces. In the middle ranges of the trench 12 x 12-inch timber will be used, use, and at the bottom 14 x 14-inch. Careful watch will be kept and if it appears that the external pressure is becoming greater than the bracing can support, intermediate lines of rangers and braces will be introduced as will be done should the sheet piling bulge between lines of rangers.

When the trench has been sheeted and excavated to bedrock, forms will be set up for the concrete core wall, which will be 12 feet thick and will in general be 4 feet inside of the sheet piling. As the core wall is completed, the space between it and the sheet piling will be filled, a clay puddle about one clay to one gravel being used on the upstream side and good soil well compacted on the downstream side. After the concrete and puddle have been completed up to the ground level, an effort will be made to draw the piles, probably using stout three-leg derricks for that purpose, and tapping the adjacent pile with a heavy hammer to loosen the bond between it and the one being drawn and between the latter and the soil.

Later, as the embankment is carried up, the core wall will be carried up with it. The height of the present construction will be made about elevation 225, while the final height of the core wall will be about elevation 285.

Practically all of the material that will be used for concrete and embankment will be brought from north of the core wall. Along the north edge of the sloping banks of the core wall trench will be located four stiff-leg derricks mounted on large platforms of 12x12 timbers, which will travel on a track of about 25 feet gauge paralelling the entire length of the core wall. These four stiff-leg derricks will be used for clam-shell excavation, for handling sheet piling and other materials used in the core wall trench, and finally for handling the concrete for the core wall. At present two are in operation, and two are under construction.



PILE DRIVERS DRIVING 80-FOOT STEEL SHEET PILES WITH STEAM HAMMER

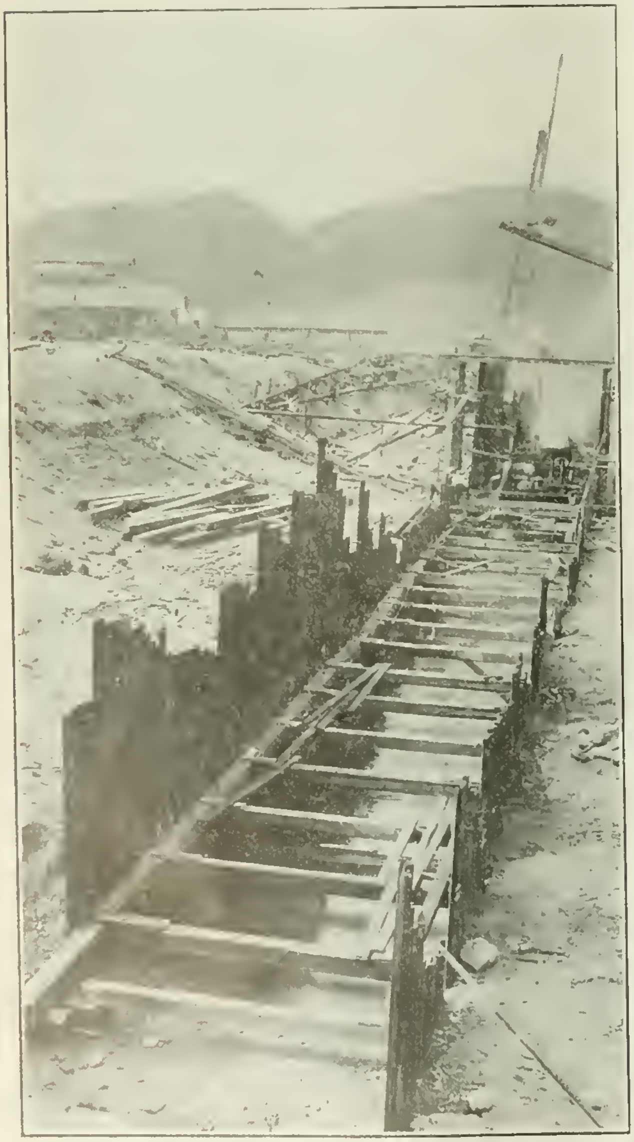
Timber frame is seen in foreground, with a few piles partly driven on each side of the trench at the farther end. At the left are seen the stiff-leg derrick and clam-shell bucket excavating the trench.

The sheet piling work is in charge of J. R. Horton, of Buffalo; a specialist in this class of work, who has been employed by the contractor for taking charge of this part of the contract.

GENERAL LAYOUT OF WORK

Near the south end of the line of the core wall was located part of a large paper mill. This has been destroyed down to the ground surface and the cellars and basement will be filled in with the hydraulicked or other material. Along the bank of the river, the low land had been filled in with paper sludge, which is considered as undesirable material to have in the embankment and this is being removed by steam shovel and side-dump railroad cars and deposited below the lower toe of the embankment.

About 200 feet north of the core wall trench is located the concrete mixer. The concrete will be brought in railroad cars from the mixer to the trench, being carried in one-yard buckets, two buckets to a car. These buckets will be picked up from the car by one of the stiff-leg derricks and their contents deposited in the core wall forms.



TRENCH FOR CORE WALL, TAKEN FROM HILL AT NORTH END

Power plant shown at left background.

The gravel and sand for the concrete will be brought from a bank about 1,000 feet farther north, where an excellent grade of material was found under about an 18-inch cover of top soil. This gravel will be screened, the larger pieces broken by a rotary crusher and the coarse and fine aggregate brought to the mixer by railroad cars. The cement is stored in a shed close to the mixer.

The aggregate brought to the mixer will be dumped into a pit from which it will be removed by a derrick and deposited in the elevated hoppers, from which it will be drawn directly into the mixer. From the mixer it will be discharged into the bottom-dump buckets referred to, which buckets, when filled, will be loaded by derrick on to the cars.

A large part of the work so far has been preparatory; clearing off the land, removing a considerable number of buildings found on the site, including the masonry buildings of the paper mill; laying lines of track for temporary wasting of top soil, material excavated from core wall trench, paper sludge and other excavated material; erecting cement storehouse, concrete mixer and its hoppers and the derrick; and erecting the screen and bins at the gravel pit, laying the track from this pit to the mixer, etc.

All of the plant will be operated by steam unless possibly some pumping may be done by electricity. A central steam plant just south of the dam site furnishes steam for all of the machinery except that at the gravel pit, for which a separate steam plant is provided. The same steam plant will also furnish steam for heating the houses occupied by the superintendents, engineers, etc., of the contractor and of the commission, and also those occupied by the laborers. At present about 250 laborers are employed on the work.

The contractor has already assembled on the ground practically all of the equipment that will be needed for the carrying on of this contract. This includes four Baldwin locomotives and two dinkies, with about 50 Western dump cars and approximately a mile of track. At the gravel pit is a centrifugal crusher manufactured by the Power & Mining Machinery Co. and operated by a Chandler & Taylor Co. engine.

There are two Ransome concrete mixers, one being kept in reserve. One mixer is set on the ground level below the hopper and the reserve mixer is kept directly behind it so that in case of a breakdown in one the other can be substituted for it in not more than thirty minutes. Stuebner bottom-dump buckets are provided for handling the concrete. The excavating at the gravel pit and also the removing of the paper mill sludge is being performed by two Marion steam shovels. The clam-shell bucket used for excavating in the trench is manufactured by the G. H. Williams Co. The dredge pump recently installed is a Morris Machine Co. 8-inch pump, 335 r. p. m., 180 h. p., and will operate against a 145-foot head. There are also pulsometer and electric pumps to be used where needed.

In wrecking the buildings on the site, a considerable amount of lumber was accumulated, most of it in fairly good condition. Advantage has been taken of this to use it in various ways. For instance, the sides of the gravel and sand bins are constructed of 2 x 4 plank laid up crib-wise with the wide side horizontal and spiked together. These are then lined with one-inch floor boards. Several of the buildings on the site are used for offices, quarters for the laborers, storehouses, etc. All of those above the dam will, of course, be removed ultimately.

The North Jersey District Water Supply Commission consists of Lawrent J. Tonnele, Ernest C. Hinck, Wood McKee and Obadiah C. Bogardus. A. H. Pratt is chief engineer of the commission, M. R. Sherrerd is consulting engineer, and N. C. Holdredge is assistant chief engineer in direct charge of the construction. R. C. Young is the superintendent for W. H. Gahagan, Inc., the contractor.

Garbage Disposal in Philadelphia, Detroit and New Orleans

In Philadelphia the garbage disposal and street cleaning, which has formerly been done by contract is now done by municipal plants and forces in the business section of the city which occupies about one-fourth of the area within the city limits, and it is estimated will be done for the year 1921 with a saving of about one quarter million dollars over the contract system, which at the end of this year will be replaced throughout the entire city by municipal operation.

The work has been organized under the direction of men previously experienced in it, is practically independent of politics, and has been very efficiently carried on. It is combined with the street cleaning and removal of ashes and is largely effected with horse-drawn wagons and sweepers, supplemented by motor trucks, in large groups in plants maintained at different stations, one of which is fitted for the transfer of refuse from horse-drawn to motor vehicles for long hauls. Pains have been taken to select simple, durable plant and standardize it as much as possible in order to promote its maintenance and reduce the number of spare parts kept in stock.

Within the next five years the city of New Orleans plans to perfect a garbage collection and disposal system and plant that will represent the last word in economy and efficiency. Within the next two years the city will spend about $800,000 derived without extra taxation from the regular 1921 budget, for garbage disposal and by the fall of the present year there will have been installed a system of garbage collection costing about $150,000.

Commissioner Black recommends that the city be divided into eight units, each of which will be provided with one motor truck and six mule-drawn trailers, each of the latter being operated by two men, will carry two containers of 2-yard capacity, which will be hauled to a central station whence trains of four to six wagons will be drawn to the dump by motor trucks The cost of this equipment is estimated at $16,000 for each unit, and will replace about 130 carts now used for the same purpose, insuring an estimated saving of one-half the money now being spent and three-quarters of the time now necessary for this work.

The city of Detroit has under consideration an offer made by a German firm which offers to construct a $1,500,000 plant at its own expense capable of disposing of the city's garbage, ashes and rubbish, and to develop sufficient steam as a by-product to furnish power for all municipal purposes. If the plant proves a success the city is asked to obligate itself to take it over.

Under the terms of the offer, the city would turn over all its garbage, rubbish and ashes to the plant which the firm is willing to build. The ashes and rubbish would be used by the plant to dry out and burn the wet garbage. Steam developed in the process would be available to the city for the generation of electric power or for heating purposes. The electrical equipment would have to be furnished by the city.

The offer was referred by the council to City Research Engineer McCabe for investigation.

Road Work in Venezuela

According to consular report the federal government in Venezuela has constructed, reconstructed or repaired since 1908 about 1,863 miles of roads and has now about 1,242 miles under construction or repair.

In the rocky, mountainous country the construction cost has amounted to a maximum of $31,000 per mile, equivalent to about $2.60 per square yard of roadbed. Telford macadam roads cost from about $.65 to $1.10 per square yard.

The road maintenance is performed by overseers who also police the traffic and can attend to from 1¼ to 2 miles of road. The work is financed by an allotment of 50 per cent of the public works revenue, which for the current year amounts to about $738,350. At present the principal operations are in the construction of the great Occidental and Oriental roads which will have lengths of about 542 and 628 miles, respectively. These roads traverse the whole republic from east to west, connecting the main productive parts of the country, and are supplemented by a number of roads to the seaboard.

Coosa River 120,000 H. P. Hydraulic Power Development

The Alabama Power Company has been licensed by the Federal Power Commission to construct at Duncans Riffle on the Coosa river, Ala., a concrete dam 1,200 feet long, to develop a head of 68 feet and retain water in a 6,000-acre reservoir. Only a portion of the potential energy will be at first developed by an installation of two 24,000-h. p. vertical units with single runner turbines and a transmission line 12 miles long to connect with the existing line of the company. Units will be located in separate enclosures on the upstream side of the dam and the draft tubes will discharge upward at the toe of the dam in order to reduce the loss of head in high water. Provision will be made for the future installation of three more units when required.

Naugatuck Valley Road

Signal and telephone service installed to control one-way traffic on portions of a very crooked concrete road built in longitudinal halves. The materials handled by industrial railway.

The state highway in the Naugatuck valley, Connecticut, runs south from Waterbury towards Bridgeport, through a very narrow valley and makes many sharp turns where it follows the contours in the bases of the hills. The new road substantially keeps to the location of the old macadam road, of which it is practically a reconstruction, but in several places the alignment is changed somewhat to eliminate bad curves or secure other advantages. There was, therefore, comparatively little grading to be done and the work consisted chiefly of removing the old macadam and building a new foundation with it and with additional materials, provided wherever necessary. Most of the foundation work was done with scrapers and steam rollers, and as there was no opportunity to detour the traffic, the new concrete surface, 20 feet wide, was built in two successive longitudinal halves, permitting traffic to be maintained without interruption, at first on the old road while the first half of the new road was being constructed, after which the traffic was transferred to the latter and the remainder of the old road was replaced by the new.

ALTERNATING ONE-WAY TRAFFIC

The number of curves and their short radius, together with the necessity of occupying part of the roadway by construction operations, limited the traffic at some points to an alternating one-way system, by which a number of vehicles from the north were allowed to pass, while the southbound traffic was held up and then the accumulated traffic for the north was permitted while the southbound vehicles were stopped, thus operating in five or ten-minute periods all day long. To regulate this traffic it was necessary to provide a large number of flagmen, especially where the curves were sharp and close together, so that at one time the cost of the flagmen was about $2,500 to $3,000 per month.

Eventually a field outfit was secured from the telephone company and a telephone was installed at each end of every section of one-way traffic. On the receipt of a telephone message at the south end of the section that ten cars were coming through, the last one No. ——, the operator at the south end would halt all northbound traffic until the last of the ten cars passed, when he in turn would telephone to the north end that ten cars were coming through, the last one No. ——, and southbound traffic would be held for them, and so on all day long, thus enabling all the intermediate flagmen on the section to be cut out, and effecting a saving of about 80 per cent in the cost of handling the traffic on the job.

The method really approximated that of railroad train dispatching and the only trouble was when a wagon would occasionally get in the way of automobile traffic and delay everything behind it until it passed off from the section. This did not, however, occur very often as few teams used the road and there was no complaint from drivers during the construction.

COST AND QUANTITIES

Broken stone was delivered by the trolley cars over an adjacent parallel track and was thus easily distributed along the line in advance of the mixer. Sand and cement were delivered by automobile trucks.

HANDLING SPOIL WITH AUTOMOBILE TRUCKS IN ROCK CUT

WIDENING ROAD BED AT CURVE

The work was done by Messetti & Holly, of Torrington, on the cost plus basis. The state paid all bills for labor and material as fast as they became due and the contractor furnished all machinery, plant, equipment and supervision, and for it received a fee amounting to 10 per cent of the engineer's preliminary estimate of the total cost of the work. The actual cost of the work, including the contractors' fee, was $405,000, and the original estimate was $400,000. Owing to the necessity of maintaining traffic, the rapidity of construction was not as great as might otherwise have been attained and the best record was for the completion of 600 linear feet of the half-width concrete in one day. The work was commenced about January 1, 1920, and completed December 1, 1920, with an average force of 75 men. The principal quantities involved included 15,000 yards of concrete, 2,500 yards of rock excavation and 32,000 yards of earth excavation.

Ideal Highway Construction

General conditions, requirements, specifications, cost and equipment for concrete paving in Minnesota and vicinity.

In making a thorough study of the construction of a one-course concrete pavement of the Minnesota specifications for 1921, various ideas and conditions were assumed that are enumerated in the general specifications that provide substantially as follows:

GENERAL SPECIFICATIONS

Subgrade. The subgrades shall consist of a graded roadway at least 30 feet on the crown in such condition that no part of it is more than one-tenth of a foot from the true grade. It shall be in such condition that no material shall be handled more than 10 feet to prepare it for concreting. The material in the roadway shall be sandy loam.

Line and Grade. The road shall be straight, except for curves that do not require widening or superelevation and shall have grades of not over 1½ per cent. No bridges, crossings or other structures shall interfere with construction operations.

The contract shall be awarded prior to January 1 in the year in which the work is to be done.

The work shall include 21 miles of paving, no part of which shall be 3½ miles from the railway siding.

Railway Facilities. Within one half mile of each 7-mile section there shall be railway facilities and within 500 feet of the highway there shall be a suitable location for its 1,000 feet of railway trackage open at both ends, and suitable storage space for aggregate and other material. There shall be train service for handling materials promptly, providing at least two switches daily.

Sources of Supply of Material. Sources of supply of material, except steel, shall be at such a distance from the unloading plant that a freight rate of $.05 per hundred pounds will apply on sand and rock. They shall be of abundant capacity and cement shall be delivered in such a way that a storage of 3,000 barrels will be adequate.

Water Supply. The water supply adjacent to the roadway shall be sufficient for at least 40 gallons per minute, and must be located so that a maximum of not more than 3 miles of 2-inch pipe will be required.

Detours. Detours will be provided and maintained by the owners so that traffic over them shall be preferred by the traveling public to traffic over the open section.

Detailed Specifications. Detailed specifications shall be the same as for the Minnesota State Highways for the year 1921: The committee does not believe that the most efficient method of laying concrete pavement has yet been definitely established and does not recommend any particular method of laying concrete pavement, the decision of which should be the result of a careful study of the geographical and financial limits of the job.

In Michigan, Illinois, Iowa, Minnesota, Oregon and Washington, the two methods in general present use for laying concrete pavement on highways are by hauling dry aggregate in trucks to the mixer and by hauling dry aggregate on railway track with locomotives to the mixer.

It is assumed that the working period of each year averages 100 working days. Capacity of the paving mixer and of necessary hauling equipment, is 400 linear feet of pavement per day per unit. The ideal job is carried out in three paving units, in one operating season. The prices of rock and sand delivered on the job are, respectively, $2.75 and $1.50 per ton, cement $2.50 per barrel and steel $.035 per pound. The wages per hour are: labor $.50, cement handlers $.65, machine operators $.75, teams $.90.

The trucks used are of 2½ tons capacity, equipped with pneumatic tires and carrying two 4-bag dry batches. For hauling by railway track, flat cars are used carrying two steel batch boxes of 4-bag capacity and hauled by 6-ton gasoline locomotives. Rock and sand are unloaded from railroad cars and stored in old charging bins by means of a 20-ton locomotive crane with 60-foot boom and a 1-yard clamshell bucket.

ESTIMATE OF COST

The principal items in the estimates are depreciation; interest at 6½ per cent on an assumed capital of $75,000 for each paving unit; supervision, including general overhead of 2 per cent; plus $5,000 salary of contractor himself in charge of three units and a foreman for each unit; taxes and licenses on automobiles; storage at 3½ per cent per annum on the plant installed; bonds at 1½ per cent on $300,000, or $4,500 for each paving unit; workmen's compensation and public liability insurance at 3 per cent of total payroll, plus fire insurance; $500 for railway fares for each unit; ground rent of $250 for camps, storage space, and tracks: $1,500 for 1,000 feet of track and switches; repairs according to the official rental schedule of the Associated General Contractors; contingencies 5 per cent; labor, fuel and oil and aggregate according to schedules presented in detail

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*Abstract of Report of Committee of Education as to Costs, Northwestern Association of General Contractors, published in July Bulletin of Associated General Contractors of America.

Losses from Watersheds

These, the principal factor in determining run-off, are of three kinds—interception by leaves, evaporation from soil and transpiration through leaves. The value of reforestation of watersheds is considered doubtful.

The New England Water Works Association appointed in 1918 a "Committee on Rainfall and Run-off Measurements," the purpose of which was "to consider the collection and standardization of rainfall and run-off measurements." A progress report was submitted by this committee in 1919. This year the committee made a report giving data collected at Hartford, Conn.; Fiskeville Dam, and Pawtucket, R. I.; Cambridge, Westfield, Southampton, and Fall River, Mass. The committee did not undertake an analysis of the records or deductions therefrom, but merely presented the measurements furnished to them tabulated according to a standard form.

Following the reading of the report before the society, however, the chairman, Robert E. Horton, gave his personal views on certain points in reply to questions by members. There we have condensed and assembled in the following paragraphs.

Apparent water losses are the principal factors, aside from rainfall, which determine the amount of run-off, being the difference between measured precipitation and run-off. Such difference is not necessarily the true or actual water loss for any short period of time, since it includes the effect of gain or loss of storage from ground water, soil, lakes, swamps, marshes, stream channels, and reservoirs.

Water losses are generally found to be more nearly constant over large areas than either precipitation or run-off, and the use of water losses as a factor in estimating or extending stream flow records is apparently increasing.

Water losses are classified by Mr. Horton as of three kinds: Precipitation that never reaches the ground; evaporation from the soil, and transpiration through leaves.

On a forested area, an average of probably 20 per cent of the rainfall is intercepted by the leaves, and may reach 25 per cent. The kind of tree affects this percentage very little. However, in case of a heavy storm the percentage that does not reach the ground may be very much smaller, while on the other hand it may be greater in case of a drizzle. In the eastern states the rate of rainfall averages a third of an inch per rain-day.

Where the land is cleared and under cultivation to clover, corn, potatoes, etc., the interception may be only 10 or 12 per cent. If farm land is allowed to run wild and grows up to wild grass, the interception might not be more than 5 or 6 per cent.

Evaporation is more in a cropped field than in a forest, and more in a bare field than in a cropped one. It may be about 10 per cent in a forest, 25 per cent in a cultivated field, and 33 per cent in uncropped land.

The percentage of rainfall that percolates through the soil and is drawn up in the roots of the plants and passes out by transpiration through the leaves is relatively large. It may be 10 to 14 inches a year for a growing crop. It may be 25 per cent in a forest, 30 per cent in a cultivated field, and only 5 or 6 per cent in uncropped open land.

From these figures it appears that the total loss might be 55 per cent in a forested area, 65 per cent on a cropped area, and 50 to 55 per cent if the area be allowed to grow wild.

This appears to indicate that forestation of watersheds is not effective as a means of increasing run-off, in fact, may decrease it; and such is Mr. Horton's tentative opinion, although he stated that he may change it when more data are available.

Whether the loss was greater or less in the case of a heavy, dense forest than in a scrub second-growth on a burned-over area he could not say. Young plants generally transpire water more readily and rapidly than do old ones in proportion to the weight of dry matter produced in the plant; but on the other hand the transpiring surface is much smaller. On which side the balance of these two counteracting effects would fall he could not say.

Asphalt-Dirt Mixed Road in Texas

A new type of road constructed by mixing dirt and asphalt is one using what is known as the Hunt Process, such a road having been built in Dallas county by L. S. Franklin and J. A. Falconer, of Dallas. The earth there is what is known as "black land."

First a trench was plowed about five inches deep as for making a gravel road, the dirt was thrown out on the shoulders and the subgrade rolled with a tamping roller. It was then given a seal coat of 2½ gallons per square yard of "Texaco" Macadam Binder. The dirt previously cast out was then thrown back to the center of the road and pulverized with harrows, tractors and rollers. Then binder was applied at the rate of one-quarter gallon per square yard for each of three applications, the earth and asphalt being mixed with spring-tooth harrows, disc harrows and mixing tampers after each application. After the final mixing, the surface was rolled with tamping rollers and finally with a regular road roller. A final seal coat was then applied to the surface of the road and lightly covered with pulverized earth. The entire mixture is about 5 inches thick and contains, including the subgrade seal and the surface seal, about four gallons of macadam binder per square yard. The tamping roller used contains tamps, each about 4 x 6 inches and the weight is about 450 pounds to the square inch of bearing surface.

Snow Surveys in California

State Department of Engineering has employed Prof. J. E. Church for making such surveys on the watersheds of that state, using special appliances. To be used for forecasting summer stream flow.

In his report recently published, describing the operations of the Department of Engineering of the State of California, W. F. McClure, State Engineer, describes, among a great number of other matters, the steps taken for securing snow surveys on the water sheds of the state, chiefly with a view to securing the data necessary for predicting the volume of spring floods and of water which will probably be available for irrigation. As he states, at most artificial reservoirs accurate records are kept so that it is known at any time how much water is available for future use, but no knowledge whatever is possessed at any time of the quantity of water stored in the vast snow fields at the heads of the streams which must come down when warm weather melts the snow.

Professor J. E. Church, Jr., of the University of Nevada, has for years been conducting studies of the phenomena connected with precipitation in the form of snow. In co-operation with the university, the local representative of the United States Weather Bureau and sympathetic friends, Professor Church had accumulated some valuable meteorological apparatus and established an observatory on the summit of Mount Rose at an altitude of 10,800 feet, overlooking Lake Tahoe. This observatory was equipped with self-recording instruments which run continuously and make written records on graphs showing the meteorological conditions for every minute of the day. These instruments accurately record the temperature, barometric pressure, atmospheric humidity, rain fall, and direction and velocity of wind. Precipitation other than in the form of rain cannot be correctly recorded and must be determined manually.

These instruments will run and make their written record without attention for six weeks, when they must be readjusted and the record sheets changed. It requires two days to make a trip to the mountain observatory by men expert in the use of snow shoes and inured to hardships. While at the summit, an observer makes determinations of the water content of the snow which has fallen, which gives a true measurement of the precipitation not measured in the rain gauges. The apparatus for measuring the water in the snow was developed by Professor Church, and two or three years ago when the California Department of Engineering took up the study of snowfall, it found that no instruments of this kind could be obtained, none being in existence except those manufactured by Professor Church. The state accordingly purchased all the equipment used by him and also engaged his services, thus insuring that the observations would be continued without a break and also arranging for training members of the department's staff in the technique of making observations. The equipment so purchased was first used for making observations in a few snow basins in the winter of 1918-19, but it was extremely difficult to obtain additional apparatus. Only recently, after nearly two years of effort and through the assistance of Professor Church, the department has accumulated sufficient apparatus to enable the investigations to be extended to several of the most important stream basins.

The department believes that after a few years' operation in a given water shed it will be able to forecast early in the season with a reasonable degree of accuracy the quantity of water that will flow in the stream later in the season. Probably reservoirs will eventually be built wherever available sites are found, to be used for both flood control and irrigation, when information shall be available as to the quantity of water held in the basins in the form of snow. In the absence of that information, the irrigator will demand that the reservoirs be filled with the first water that comes, for if held empty on the chance of high water later, there may not be enough to fill the reservoirs for his use. On the other hand, those whose lands are subject to injury from floods will contend that the reservoirs must not be filled until the danger of floods is passed, else when the flood does arrive there will be no storage space for it. If definite information is had as to the quantity of water being held in reserve by the small fields, however, it will be known in advance when it will be safe to fill the reservoirs. Moreover, if an irrigator should know in the spring that the snow will furnish insufficient summer water, he will not plant crops requiring late irrigation.

The studies so far conducted have enabled a start to be made in forecasting, and though the data have not been as complete as they will be when the system becomes fully developed, the close agreement of the prognostication with the measured run-off in the instances attempted has been very gratifying.

The data obtained from the recording instruments at the observatories give information as to meteorological conditions preceding and during the accumulation of snow. From these records it is known whether the ground was primed with water before the snow fell or whether it was dry and absorbent; whether it was frozen so as to resist the penetration of the water from melting snow.

To obtain a sample of snow, a straight steel tube armed with a serrated annular cutting bit of a peculiar pattern is used. The bit is brazed or sweated into the hollow shaft (not screwed on) so that there is no joint to catch the snow. The tube is made up in sections for convenient transportation and handling and is screwed together to make lengths up to about 16 feet. The couplings are so made that the sections butt together in a smooth joint. The tube has narrow slots cut in the walls on opposite sides so as to break joints and not weaken the shaft. These slots serve as windows through which to observe the column of snow within and through which to insert a tool for cleaning out the snow. On the outside of the tube is a gauge etched in the metal graduated in inches, measured from the edge of the cutter. The inside surface of the tubes is machined and polished to a high degree and the interior is varnished after being used in order to eliminate friction of the snow to the greatest degree. The couplings are made as thin as consistent with the requisite strength and turned down to a feather edge at the ends so as to offer least resistance to penetrating the snow.

The sample of snow is obtained by forcing the tube to the bottom, to do which a heavy wrench is applied, by which to turn the tube and upon which weight is applied to force it down. The rotary motion is necessary to cut through layers of frozen snow. As the tube descends, it cuts out a column of snow which rises inside. When the bottom has been reached, the tube is taken up and weighed. The weight of the empty tube is known and the scale calibrated so as to express the net weight of snow in inches of water.

The scale is of the spring balance type but is more carefully constructed and calibrated than are any of the stock scales found in the market.

A "snow survey" consists of selecting courses which seem to the operator typical of average conditions in the snow field and taking many, sometimes hundreds of samples of snow, each of which is weighed for its water content. In a small field or one with uniform topography and exposure, one or a few courses will be sufficient; but in a broken and rugged country covered with timber, a great many courses may be required to obtain a good average. The work is done in high mountains, remote from habitations, and is strenuous to an extreme degree. It requires men of good health, inured to hardships, endowed with sound judgment, unyielding determination, possessing good knowledge of woodcraft and acquainted with the geography of the country. The operator must carry, in addition to his instruments, food and bedding for camping overnight. The department has made a rigid rule that no trip into dangerous territory shall be made by one man alone but always with a companion, since an accident which might be trivial elsewhere becomes a momentous matter in these remote regions, and serious injury or storm means almost certain death.

$6,000,000 California State Highway Contracts

Thirty-five new contracts for approximately six million dollars' worth of work have been let by the California Highway Commission during the first six months of 1921.

This work was distributed all over California and bids on other sections are being asked and a large highway program is well under way.

The 1921 contracts that have thus far been let are for work in the following counties: Fresno, Tehama, Shasta, Santa Barbara, Kern, Humboldt, Butte, San Luis Obispo, Mendocino, Placer, Nevada, Sacramento, Amador, Solano, San Mateo, Tulare, Los Angeles, San Diego, Mono, Mariposa and Glenn.

Labor for Unemployed on California Highways

The state highway engineer of California, A. B. Fletcher, estimated that at the end of July there were 2,500 men employed on highway contract and maintenance work in that state, 1,500 of these being on contract work. The recent sale of $4,-780,000 worth of highway bonds will enable the highway commission to let more highway contracts, providing work for hundreds of more men.

Since January 1, 1921, sixty-three contracts have been let, totaling $7,916,875.

Sewerage Conditions in Indianapolis

It is estimated that only 65 per cent of the houses of Indianapolis are connected with sewers where sewers and water are available, while, in addition, there are many parts of the city where they are not available. Open vaults consequently exist by the thousand in the city, and the city health department, which has recently completed a sanitary survey of the city, asks the city council to pass an ordinance prohibiting the maintenance of open vaults within the city after October 25; and requiring that all houses be connected with the sewers and water where these are available, and where they are not that septic tanks be installed. One of the objectionable features of the vaults is that "there are being hauled through the streets daily from 75 to 100 loads of night soil, which is dumped on the ground less than two miles from the heart of the city. . . . The night soil wagons and cleaning outfits are an offense against common decency and an insult to public health," according to Dr. Herman G. Morgan, secretary to the health department.

Another cause of insanitary conditions is that "many sanitary sewers in nearly every part of the city are not operating properly. The trouble often is caused by stopping up the interceptor. The overflow then dumps raw sewage into streams that pass through the residence districts. In some of the best residence sections it is almost constantly possible to detect the odor of sewer gas. Complaints have been received by us repeatedly, and found to be well-founded." This condition is partly due to the fact that sewer-cleaning gangs are not properly supervised and that much of their work is not done properly.

Philadelphia-Camden Bridge

The board of engineers in charge of the construction of the Philadelphia-Camden bridge across the Delaware river consists of Ralph Modjeski, chairman and chief engineer, George S. Webster and Lawrence A. Ball, who will have complete charge of the design and construction of the bridge and will advise the bridge commission on all matters pertaining to the project, will employ experts when necessary, and maintain an inspection department, an assistant to the chief engineer and chairman, an engineer for the design of the approaches, an engineer of the design of the main bridge and three engineers of construction.

PUBLIC WORKS
Published Weekly
by
Public Works Journal Corporation
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba..$3.00 year
All other countries ....$1.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
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Reforestation of Watersheds

Is the yield of a watershed diminished by cutting off the trees or increased by reforesting? This question stands without a generally accepted answer after many decades of discussion and investigation. Forestry enthusiasts claim it is. Others dispute it or at least insist that it has not been proved. In this issue a water works engineer who has studied the problem gives it as his tentative opinion that the yield is greater when trees have been cut off and the ground allowed to grow up to wild grass, and questions the advisabality of reforesting a water works watershed.

It seems to us, however, that decision as to reforestation should not rest solely upon the results obtainable in increasing total yield. Total yield is important, but is less so in most cases than uniformity of yield, decreasing erosion of soil, reducing evaporation from reservoir surface by diminishing wind velocities across it; all of which result, we believe, from the presence of trees on a hilly or mountainous watersheds, and most watersheds (or catchment areas, as they are more appropriately called by some) in the eastern states are hilly or mountainous.

There would seem to be no question that the roots of trees and the forest mat of dead leaves and wood prevent erosion on slopes, and greatly increase the percolation of water into the soil and and the resulting ground storage. This means less immediate run-off from rains and therefore less loss over the spillway. It also means less sediment carried into the reservoir to diminish its capacity, and less turbidity to be removed from the water.

Another argument in favor of reforestation is the profit of it considered as an investment. By scientific cutting of the trees and yearly replanting, a wooded watershed may be made a source of continual revenue, most of the labor on it being done at times when the regular force of the department or water company have no other outside work on hand. Several instances of this have been described by us during the past few years.

Fixed Fee Road Contracts

The use of a special cost-plus basis of contract for construction of concrete highways under difficult and uncertain conditions is found satisfactory by the State Highway Department of Connecticut as illustrated by the description in this issue of a half million dollar job that was somewhat hampered by maintaining traffic on a crooked line under construction.

All of the Connecticut state road maintenance is done on force account and most of the new construction, including bridges of the longest spans, by competitive contract, either lump sum or unit price.

On special occasions where conditions preclude exact estimates, and lump sum or equivalent contracts are likely to involve uncertainty and high prices, a special contract providing for the payment of all labor, material and equipment costs, plus a predetermined fee for supervision and contractor's profit, has been found practical and satisfactory. The fixed fee has been approximately proportioned to the total reasonable cost of the work by making it an agreed percentage of the engineer's preliminary estimate.

So far this form of contract has been adopted in cases where particular difficulties and uncertainties were anticipated, making it impractiable to provide satisfactorily for them in the specifications; as when unforeseen difficulties impede the handling of the traffic or may delay the work and cause additional expense. This burden, and that due to arbitrary charges, should properly fall on the owner where it is placed by this arrangement that also settles on him the entire cost and all risks and on the other hand frees him from paying undue profits.

Properly administered, accounted, and executed, such a contract as this is not far from ideal under certain conditions, although it has the possible objections of eliminating general competition and removing the incentive for extraordinary efforts to reduce cost. It is, of course, possible to reduce these disadvantages by permitting the contractor to bid a minimum amount of percentage he would accept, and by offering a bonus of a certain percentage of any saving effected over the engineer's preliminary estimate. The latter may, however, be held to imply a corresponding over-payment when extra cost is developed. The desirability of such a step must necessarily depend to a large degree on the character of the work and on the wording and proper enforcement of the contract and specifications.

Under favorable and well-defined conditions where there are many or large standard items that afford special opportunity for excellent management and commercial and financial manipulations, the award to the lowest bidder for a fixed price or unit price stimulates competition and the effort to introduce advantageous management and operation.

Where there are great uncertainties, delays or the probability of important changes, the cost-plus system is attractive, provided exceptional ability and integrity of the contractor and his familiarity with the same kind of work, and the provision of abundant equipment of all necessary plant, machinery, and complete executive organization without extra charge, is assured.

The specifications should leave no possibility of disagreement as to the furnishing by the contractor of all equipment of every sort that is used and the inclusion of all kinds of supervision and direction so that no extras of any sort will be charged and that there will be no incentive to hold plant idle on the job in order to rent it at large prices, to supply unnecessary equipment, or to provide occupation for supervision not necessary on the work. It is well demonstrated that no possible type of contract is best adapted for all conditions, but this form seems to have positive advantages for the conditions under which it has been successfully used.

Shelburne Mountain Road

Heavy construction on a $300,000 contract for 5 miles of concrete highway in Massachusetts in the Mohawk Trail region. Heavy grades eliminated by location requiring many preliminary surveys. Cost increased by one-way delivery of materials. Abundance of power equipment installed. Average progress nearly 300 linear feet of 18-foot pavement daily. Sand and concrete tests notably above specification requirements.

The Shelburne Mountain road, now under construction through the beautiful scenic regions in District No. 2 of the Massachusetts Division of Highways, involves a large amount of heavy construction. The route was designed and construction begun under the control of the State Department of Highways, A. W. Dean, chief engineer, F. C. Pillsbury, construction engineer, and H. D. Phillips, district engineer. The contract, amounting to about $300,000, was awarded to Coleman Brothers & Co., Inc., of Boston, P. J. Burns, superintendent. The work was commenced September 1919, is now more than 75 per cent finished, and it is expected will be completed this season.

The alignment, about 5 miles long, consists of tangents connected by long radius banked curves with maximum grades of 6 per cent, one of them having a length of nearly 9,000 feet. The road winds through a very beautiful and picturesque region, forming an approach to the historic Mohawk trail used by the war parties when attacking the Pocumtuck tribe in Deerfield.

The location was very difficult and required a great deal of reconnaissance and surveys extending over several years. Half a dozen or more preliminary locations were made by the State Highway Department and trial lines estimated from the stadia and vertical arc measurements eventually culminating in the selection of a route that eliminates the last steep grade (12 per cent) remaining in the route from Boston to Williamstown and Albany.

About two-thirds of the location is an entirely new line, most of it terraced out of rocky hillsides, involving about 40,000 yards of earth and 16,000 of rock excavation, just about balancing the required fills and embankments with moderate-length hauls averaging about 1,000 feet. The width of the hardened roadway is 18 feet, increased to 21 feet on curves, which are well banked.

In the final location the center line stakes are driven 50 feet apart and one on each side and on each of them is inscribed the elevation marked with Dixon's lumberman's blue crayon that will be legible for years. Slope stakes are set at the tops of deep cuts and at the bottoms of high fills. At all points the line and elevation are given by the resident engineer to the contractor's superintendent and are transferred to subgrade and the finished work by chalk line, level and straight-edge. The different stages of the work are checked up by instruments as soon as completed and any material deviations are immediately corrected. Generally the state has secured a right of way 100 feet wide, nowhere less than 70 feet wide, allowing ample room for slopes and protection against falling trees, landslides, rolling boulders and the like.

In some places where the road winds along high on the hillside it commands beautiful prospects and distant views of New Hampshire and Vermont mountains and it is proposed to secure the funds and authority necessary for building occasional lookouts carried beyond the roadway and protected, if necessary, by high retaining walls and massive parapets, which will greatly enhance the road for touring.

Great pains are taken to secure a substantial foundation and to drain it thoroughly, thus providing for durable, strong bearing surfaces. Ditches, tile drains, blind drains and the like are abundant and the drainage from them flows away rapidly to the brooks or streams in the vicinity. In wet hillside cuts, ditches are excavated 10 feet clear of and parallel to the edge of concrete surface, and are carried down about 2½ feet below grade, and drained through pipes or culverts.

Considerable drilling and blasting were required in the deep cuts to shatter the rock so that it could be handled by the two ¾-yard Erie steam shovels, each of which delivered the spoil to from 10 to 20 teams that hauled it directly to the nearest fill. Ingersoll-Rand tripod and jackhammer drills were always operated in advance of the steam shovels to shatter the earth and rock and also for a considerable amount of block holing. Light holes were charged with 40 per cent, and heavy ones with 60 per cent dynamite, but none of them were sprung. The drills were operated with compressed air that was provided by a 20 h. p. Sullivan compressor and steam for it and other purposes was supplied by four portable vertical boilers. The shovels were always moved before each blast of the working face in rock cuts.

The cuts were made 24 feet wide on the bottom and the embankments were from 24 to 28 feet wide on top and the slopes were rip-rapped when at 45 degree angles. The slopes of rock cuts were ¼:1 and of earth cuts 1½:1. The deepest cuts were 20 feet and the highest embankments were also 20 feet. In all cases where embankments were built on side hills the latter were plowed before the fill was placed. The embankments were finished with a natural slope, no retaining walls being built. Earth embankments were made with 12-inch layers, that were so well compacted by horse-drawn rollers that no settlement occurred in them after the road was built on them.

All foundations were made with 12 to 18-inch layers of rock from 8 inches in diameter down to fine pieces and were underlaid in wet places with 6 inches of sandy gravel to afford additional drainage. The stone foundations were carefully hand packed and the voids filled with sand, thoroughly rolled with a 12-ton Buffalo-Pitts machine. The stone foundations are built accurately to subgrade, and are tested with a template riding on the side forms just ahead of the construction of the concrete pavement.

The cement, sand and stone conform to the requirements of the Federal Aid Road specifications, the sand being of a remarkably fine quality that is more than 100 per cent of the test requirements.

The cost of the work was materially increased by the necessity of hauling all road materials from one end only of the line. Cement was hauled daily, distances ranging from ½ mile to 6 miles and was delivered only as required, only a dozen or so bags being left over night on the job. The stone and sand were hauled from 2½ to 7½ miles in 3-ton and 4½-ton Mack trucks.

Aggregate was hauled over the completed roadway and delivered in piles on the subgrade adjacent to the 2-bag Koehring mixer, that early in the season had run at an average rate of about 275 linear feet daily, equivalent to 290 cubic feet of concrete, a progress which has since been increased to about 300 linear feet per day. The 1:2:4 concrete contains 8 per cent of the cement bulk of hydrated lime and is required to be mixed for one minute.

The concrete, dumped from the bucket of the mixing machine, is approximately spread by hand, shoveled and raked, and on tangents is finished by a Lakewood tamping and finishing machine. The machine cannot be operated on curves and therefore the banked surfaces are finished by hand, being screeded with a 48-pound rail, dragged by four men, after which the surface is floated by men working on bridges. The surface is later roughened with stable brooms.

The concrete is placed between Blaw-Knox forms, of which 1,200 linear feet are provided. Water, at 100 pounds pressure, for concrete mixing, curing and other purposes, is delivered through a 1½-inch pipe laid by the contractor and connected to a Dean steam pump at the section, which is shifted every mile or so to draw from the more convenient supplies which are found in abundance all along the line.

The contractor has about 300 linear feet of 6 x 22-foot light wooden frames 2 feet high that are covered with canvas and protect each day's section of fresh concrete until it has set and after an average time of 16 hours is covered with 2 inches of earth and for 2 weeks is kept saturated with water, two or three men constantly being employed spraying it with hose from the service pipe alongside. The total force averages about 80 men.

Expansion joints are provided at the end of every quarter day's work and great care is taken to make them exactly at right angles to subgrade. They are made with 3-ply asphalted paper.

Daily slump tests are made of concrete, taken fresh from the pavement, and placed in a truncated conical sheet steel form 12 inches high, 8 inches in diameter at the base, 4 inches at the top. The test concrete is thoroughly rodded with a ½-inch diameter pointed pin, the top is carefully leveled, and the form immediately withdrawn, permitting the concrete to slump without restraint. The average amount observed has been ¾ inch for concrete that has been tamped with the Lakewood machine and 1 inch for hand concrete, although the specification allows slumps of 1½ inches and 3 inches, respectively, for these conditions. It is considered that a large factor in obtaining these results is the close adherence to the theoretical water content of the concrete, the water ratio being maintained at one, which makes a dry and uniform, plastic product, which has proven very satisfactory. The numerous slump tests made have been allowed to harden alongside the road and many of the specimens may still be noticed where they have been abandoned, that look almost as perfect and symmetrical as though they had hardened in the form without being removed or slumping at all.

The work is being executed by an average force of about 12 two-horse teams, 7 trucks, and 80 men, first class labor being abundant at prices varying from 35 to 50 cents per hour.

Charleston's New Filter

Plant of fourteen million gallons capacity constructed under supervision of department for less than the lowest bid received.

The Water Department of Charleston, S. C., has built by day labor a new filtration plant to take the place of the old "tub" filters, and believes that it has saved money thereby, besides saving itself a lawsuit and much annoyance that would have resulted from the unforeseen conditions that a contractor would have encountered.

The plant contains fourteen one-million-gallon concrete filter units with "Wheeler" bottoms. An old standpipe erected in 1880 was taken down and re-erected for use as a wash-water tank.

The manager and engineer of the department, J. E. Gibson, secured authority to build the plant under his own management rather than by contract, and contracts for materials, including a construction plant, were entered into early in 1920. The construction plant cost $10,150 and $368 additional was paid out for small tools.

The razing of the old standpipe was completed early in January and re-erected on the new foundation completed in April, the standpipe going into service on April 22, when the removal of the old filter plant was begun. One filter unit was poured on May 27, another on June 17 and two filters on July 15. Construction of the Wheeler bottoms was begun the second week in July and the first filter went into service October 5, a second 20 days later and the third, December 15.

Two more filters were poured on November 5, two on November 30 and two on December 21. By January 1 of this year three filters were in service of the eight that had been poured.

The work was greatly delayed by difficulty in having material delivered, little construction being done between the middle of July and October, when the forces were more or less disorganized.

It was estimated that the cost of the plant complete would be $123,213, including the cost of the construction plant which was estimated to have a salvage value of $3,000, leaving the net cost about $120,000, including the standpipe, outside piping, engineering and other expenses. The original estimate was $118,300, but this was made before the increase in cost of materials, freight and labor of 1920. Further, the cost was increased by the delays and by the necessity of maintaining the supply of water to the city meantime. Concerning the cost, Mr. Gibson said:

> All of these contingencies were in a measure considered in making our original estimate, but no one other than a pessimist could have foreseen all of the difficulties to be encountered in this operation
>
> We are satisfied that had we let this work by contract, we would have been subjected to inconveniences, arguments and claims for liquidated damages due to the inevitable delays incident to maintaining the water supply service. These claims would have probably resulted in legal proceedings before they could have been satisfactorily adjusted.
>
> As the work progressed your officers were more than ever convinced of the wisdom of the commission in authorizing the department to carry on this work under their own management, and we believe this view is entertained by the members of the Commission.
>
> The lowest contract bid received, you will recall, amounted to $127,050, and therefore it is seen that we will probably effect an actual saving of $7,000 in cash, plus whatever claims the contractor might have presented and collected, rather than go to law, not considering the arguments and bickerings which would have arisen by lack of co-ordination between the contractor and the department forces.

MUNICIPAL USE OF WATER

The department furnished fire protection through 629 hydrants and the city had the right to use 300,000 gallons per day for flushing sewers and other corporate purposes. For this service the city paid $44,000 a year plus $25 per hydrant for all hydrants in excess of 600.

It was found that the city was using more than 700,000 gallons a day for sewer flushing alone. Meters had been installed upon all municipal services except the sewer flush tanks, and upon discovering the excessive use of water by these, periodic inspection and tests were made to keep the waste of water by them within a reasonable amount. This was doubly important, as all of the sewage had to be pumped. The water used by the flush tanks during 1920 was estimated to have been 14,600,000 cubic feet, valued at $13,900.

The other municipal uses for the year totaled 7,522,380 cubic feet, valued at $10,440. This is 50 per cent more than the amount arranged for and by co-operation with the managers of various city institutions the department hopes to eliminate most of the useless waste by these services.

Of the 9,430 taps on the system, 98.4 per cent were metered at the end of 1920, and it is hoped to meter practically all of the remainder this year.

Of all the water filtered and pumped to the city during the year, 80.4 per cent was recorded by service meters, at times 85 per cent being accounted for. It is believed that an average of 85 per cent of all water pumped will be metered and billed when the services are all metered.

On account of the nature of the soil it is found advisable to lay all services of lead pipe. There are a great many galvanized iron services in the city and many small wrought iron mains laid by property holders, and the latter are being replaced by cast iron and the former by lead, more than $3,000 having been spent in this work last year.

Consulting Engineers J. V. Davies and Ralph Modjeski have reported to the San Francisco Motor Car Dealers' Association recommending the construction of a road from near Mission Rock to the proposed naval base in Alameda which would include about 3,000 linear feet of tunnel, consisting of three parallel tubes providing altogether for one 20-foot roadway and two railroad tracks, and 12,000 feet of bridge spans followed by a concrete pile viaduct and a filled causeway. All to have an estimated cost of about $40,000,000 and to be completed in about four years after construction is commenced.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Handle and Erect Girder Spans Without Special Equipment—V*

With ginpoles and moveable derricks.

When derricks, locomotive cranes or other hoisting apparatus are not available, girders of about 10 tons weight may be loaded, unloaded, raised, lowered, shifted a few feet horizontally and erected by the use of the ginpole, which is virtually a guyed mast with a hoisting tackle suspended from it. Girders heavier than 10 tons may be handled by a pair of ordinary ginpoles or by one or two ginpoles of extra strength.

Ordinarily a ginpole consists of any convenient stick of sound timber, 6 inches or more in diameter and 20 feet or more in length with the square lower end seated on an ample timber sill and a hoisting tackle of four parts or more suspended from the top, which is guyed by at least four and preferably by six or eight inclined stays that make the smallest practicable angle with the horizontal and are securely attached to the mast and to their anchorages.

STRENGTH OF LOAD

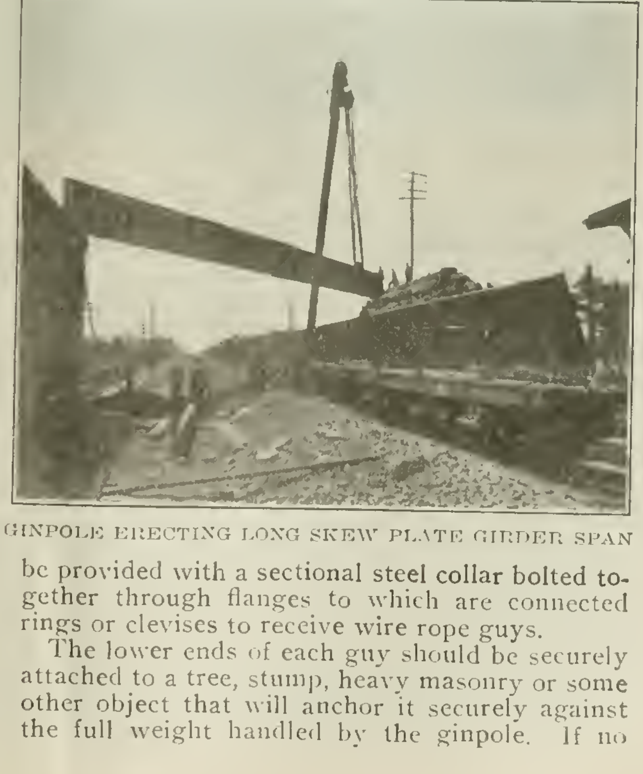
The strength of a ginpole is greatest when the bottom has full even bearing on the horizontal surface and least when it is rounded or takes bearing only at a single point. It is greatest for well seasoned sound timber and may be greatly reduced if the timber is green and has imperfections which may be hidden. Ordinarily if the load is at all heavy in proportion to the nominal strength of the ginpole, it should be lifted cautiously and in all cases the ginpole should be carefully watched to see that it shows no signs of distortion, displacement or failure. Care should always be taken not to pass under the load.

The nominal safe load for square, sound, well seasoned yellow pine ginpoles for a 6 x 6-inch cross section, 14 feet long, is about 4 tons; for 8 x 8-inch cross section, 20 feet long, about 7 tons; for a 10 x 10-inch, 20 feet long, 14 tons. The strength of a ginpole decreases rapidly as the length increases, so that a 10 x 10-inch ginpole, 35 feet high should not be loaded more than 4 or 5 tons at the most, while a 12 x 12-inch ginpole should not be loaded with more than 7 tons for a length of 35 feet or 5 tons for a length of 50 feet.

SPECIAL GINPOLES AND RIGGING

If it is necessary to load a ginpole above a safe amount, the pole can be strengthened by reinforcing the center portions with planks or timbers clamped to it, or by hog trussing it on all sides. Ginpoles of great strength can be made with four full-length square pieces from 4 x 4-inch up to any convenient cross section, placed at the corners of a rectangular from 1 to 4 feet square, and connected by cross pieces and lattice bracing thoroughly bolted on. In making such a compound ginpole, it may be convenient to bend the corner pieces so that they converge toward each other at both ends where they should be enclosed with steel hoops or collars so that they will unite solidly together.

For a small ginpole, manila rope guys secured to the top with proper hitches that cannot slip may be used. For larger jobs the tops should be provided with a sectional steel collar bolted together through flanges to which are connected rings or clevises to receive wire rope guys.



GINPOLE ERECTING LONG SKEW PLATE GIRDER SPAN

The lower ends of each guy should be securely attached to a tree, stump, heavy masonry or some other object that will anchor it securely against the full weight handled by the ginpole. If no anchorage is available, one can be provided by attaching the end of the guy to a horizontal timber 6 feet or more in length that takes bearing against vertical posts that form part of a heavily loaded platform, or that is buried several feet deep in a trench excavated for the purpose. The guys should be connected to their anchorages with small tackles that allow them to be slacked off or tightened safely under heavy stress.

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*Part I.—Transportation to site and erecting by steam protrusion was published July 3.

Part II.—Erection by cribbing, jacking, rolling and skidding was published July 30.

Part III.—With fixed and moveable derricks was published August 6.

Part IV.—With locomotive cranes, derrick cars and wrecking cars was published ? ? ?

If no hoisting engine is available, the tackle suspended from the ginpole is usually operated by a hand windlass or crab bolted to the ginpole just above the foot and manned by two or four laborers. When one ginpole is inadequate, two may be used, one near each end of the girder.

When two ginpoles are used for handling a single girder considerable elasticity of arrangement and operation is possible and under certain conditions both ginpoles may be placed on the same side of the girder, or one may be on each side; they may be located symmetrically or at different distances from the center of gravity of the girder and may thus be forced to take equal or unequal portions of its weight.

INSTALLATION OF GINPOLES

The guys, hoisting tackle, and the windlass or crab, if there is one, should be attached to the ginpole while it is in a horizontal position on the ground. If it is a small pole the top can then be lifted by hand, the bottom securely held in place and the pole gradually revolved to its vertical by men hauling on the guys. Longer and heavier ginpoles can be raised to an angle of 20 or 30 degrees by a light tackle suspended from a sheer leg and attached to the ginpole just above the center of gravity, thus elevating it to an inclination at which it can be revolved to vertical by pulling on the guy lines, which may be operated by tackles or by the windlass. In any event attendants must be stationed at all of the guys, slacking off on the front guys, but keeping them under control to act as preventors and not allow the ginpole to revolve backward or sideways from the vertical.

ERECTING LONG PLATE GIRDER WITH TWO GINPOLES

After the ginpole has been plumbed, the backstays should be slacked off slightly so as to move the top of the pole a foot or two toward the load so that it overhangs it slightly, swinging the hoisting tackle clear of the pole when it hangs free. After the load is hoisted, the guys may be slacked off and taken up so as to swing the load a short distance horizontally away from the ginpole, but the latter should never be allowed to become more than 1 in 12 out of plumb, and very great care should be taken to command the guys in a way that will make it impossible for them to slip.

SHIFTING LOAD ON GINPOLE

If the girder is secured at the bottom of its piers or abutments it may be unloaded parallel to them and hoisted in that position by the ginpoles set between the abutments, and after hoisting to the required elevation the girder may be revolved horizontally while suspended from the ginpole so that its ends are above the masonry bridge seat, to which it can be lowered in a single operation, or it may be lowered to greased rails or other skids on top of the piers or abutments and pushed transversely to the required position, then raised again and lowered to its final seat.

With care a ginpole can be moved a considerable distance horizontally without lowering it to the ground. For this purpose connections should be provided near the bottom for horizontal bars by which the ginpole can be lifted by two or more men on each bar orb y jacking and a plank inserted under it on which the foot of the ginpoles is pushed along with pinchbars.

A man must be stationed at the foot of each guy hauling in those in front and carefully securing the slack and easing off on those behind so as to always keep the pole nearly vertical with the top overhanging slightly in the direction in which it is moved. The bottom should never be placed on rollers.

BREAST DERRICKS, A-FRAMES AND TRIPODS

A breast derrick or an A-frame may be substituted in many places for a ginpole, especially if there is considerable light work to be done and it has to be moved frequently. The A-frame simply consists of two inclined posts, securely fastened together at the top and having their lower ends seated on and firmly attached to a sill. The inclined posts are usually braced together intermediately and a hand windlass or crab attached to the bracing near the foot. Guys are attached to the top of the A-frame, at least two of which must be for backstays, and one in front; four or six guys are required for heavy work. The A-frame should slightly overhang the load so as to allow the hoisting tackle to fall free: it has a greater lifting capacity than a single ginpole of similar dimensions, is much more easily moved, and has greater stability.

For lifting very heavy loads that do not require to be shifted much transversely three poles of convenient size and length may be lashed or bolted securely together at the top, directly over the center of gravity of the load, and the feet of the poles securely seated at the vertices of an equilateral triangle, one side of which is preferably parallel to the girder, which should pass through the center of gravity of the triangle.

The Port of New York District

The recent creation of the Port of New York, including the city of New York and the industrial district in the northern part of New Jersey in a single unit covered by the Port of New York Authority provided by a compact between the states of New York and New Jersey and unanimously endorsed by vote of congress, is a very important factor for the best and most rapid development of commercial and industrial interests that affect not only the business and prosperity of the great metropolitan center, but include more than half of the total foreign commerce of the United States, that amount passing through the port of New York alone.

The district with its population of 8,000,000, its vast liquid and invested capital, and enormous commercial, industrial and transportation interests has almost unlimited resources and opportunities dependent upon very unbalanced conditions due to the tremendous congestion in some portions of the territory that are offset by the potential opportunities for development of large areas of unoccupied land and waterfront capable of being developed under broad and well-digested plans for a co-ordination of great business that without question might exceed in value and importance that of any other center in the world, and that would demand and justify many millions of dollars' worth of construction a year.

In the fiscal year ending August 1, 1914, the last normal year before the war, 76,000,000 tons of freight moved through the port by rail and 45,000,000 tons by water. A substantial percentage of this consisted of perishable foodstuffs, which had to be delivered promptly.

There has never yet been perfected any intelligent, comprehensive plan for receiving and distributing this tremendous tonnage. Of the 76,000,000 tons of freight which moved through the port by rail in 1914, 53,359,000 tons were for local use. Taking the average tonnage of a freight car, this tonnage for local consumption used 3,000,000 freight cars, or 25,000 miles of freight cars.

It is estimated that 45,000,000 tons of freight, enough to fill a line of freight cars reaching halfway around the world, entered or left the port of New York by water in 1914, exclusive of Hudson river and Sound vessels. Eight thousand four hundred vessels, with a capacity of 24,000,000 net tons—a ton being a unit of 100 cubic feet—cleared from the port of New York in 1914.

Although New York handles over 50 per cent of the foreign commerce of the United States, less than 3 per cent of all federal appropriations for rivers and harbors have been expended in New York river and harbor development.

The port of New York, with its three entrances, 800 miles of waterfront, 12 railroads, exclusive of local transit lines, entering the port, a terminus for nearly all of the more important transatlantic lines, not only concerns the people of the two states, but constitutes an asset of the entire nation. The necessity of creating the port district and authorizing the creation of the port authority is manifest from the fact that over forty municipalities are involved, some of them controlled by men of divergent views and many of whom have been working at cross-purposes and in the dark.

Canals in Great Britain

The use of canals and navigable rivers for the transportation of fuel and other bulky freight has been much more developed in Great Britain than in this country and has effected so much economy and improvement of transportation that considerable concern has been felt on account of the gradual absorption of the canals by the railways. In 1909 the total number of miles of canals and navigable rivers in use in the United Kingdom was 4,670. The natural center of the British canal system is the city of Birmingham, where in a 30-mile square the Birmingham canal navigation system has 159 miles of artificial waterways and 212 locks, and supplies 180 plants and manufacturers with fuel. From Birmingham the main canal routes include 147 miles and 166 locks to London; 140 miles with 101 locks to Liverpool; 162 miles with 66 locks to Hull and to Sharpness, one route of 75½ miles with 61 locks and an alternative of 89 miles with 49 locks.

Unfortunately the dimensions and capacity of the locks vary so that the traffic is limited at different places to vessels from about 70 feet long and 6 feet 9 inches wide, to a maximum of 145 feet long and 22 feet wide, the depth of the canals in some places averaging only about 3½ feet long and 22 feet wide, the depth of the capacity from 28 tons to 1,200 tons for the different sized boats at different portions of the system about one-third of which is limited to the smallest size boat mentioned.

According to American canal standards the dimensions of these canals would rank them little above feeders, but a realization of the benefits derived from such an imperfect system should make for more careful consideration of the improvements of our rivers and the establishment of locks and connections that would enable slow freight to be transported in vastly greater quantities on our inland waterways.

A Suspended Dump Track

The upstream and downstream toes of the earth dam across the Miami river at Taylorsville have been built by the Roberts Brothers, Chicago, for the Miami Conservancy District.

The spoil used for making the toe embankments was delivered in side-dump cars, pushed by the locomotive on a track laid on top of the embankment and continued beyond it on a suspension bridge having four 1¼-inch Hercules red strand wires ropes, 502 feet long, made by the Leschen & Sons Rope Co., St. Louis. The ropes were symmetrically arranged one foot six inches from the center line, and supported track ties 2 feet apart bolted to the outer cables. Each cable was equipped with a special bridge socket and take-up for the required adjustment which did not exceed 15 inches. The equipment was in use for about one month, after which the cables, which were in good condition, were used for swinging cables on steam shovels.

DISCRETION OF MUNICIPALITY OWNING WATER WORKS TO DETERMINE WHAT EXTENSIONS WILL BE MADE

The Wisconsin Railroad Commission is of opinion that a municipally owned utility should exercise a somewhat wider discretion in determining the conditions under which extensions will be built than a privately owned utility, inasmuch as the former is presumably under the control of and representative of the public. The rules for future extensions filed with the commission for the municipal water plant at Fond du Lac contain the following provisions: "The water department will lay water mains wherever needed as rapidly as funds are available, for such extensions. The department, however, reserves the right to determine when such extensions will be made, and upon what terms or under what arrangements with applicants the work shall be authorized and carried to completion. The interests of the taxpayers and the consumers of service must be considered in connection with applications for extensions and the department cannot be expected to order such extensions unless public policy or the prospective income from the consumers taking service from the new main will justify the expenditure."

A UTILITY LEASED TO A PRIVATE COMPANY IS MUNICIPALLY OWNED AS REGARDS THE COMMISSION'S JURISDICTION

The Illinois Public Utilities Commission, denying its jurisdiction to pass upon the rates for electric service proposed by the Louisville Light & Water Company, holds that a public utility which is leased by a municipality to a private company is municipally owned, so far as the jurisdiction of the commission is concerned, and the commission has no jurisdiction over the rates for service furnished by a municipally owned plant.

ACCEPTANCE OF STREET PRESUPPOSES OPTION IN MUNICIPALITY

The Alabama Supreme Court holds, Town of Clanton v. Chilton County, 87 So. 345, that where a county without authority used road and bridge funds for the improvement of a street, the town was not liable on an implied contract on the theory of acceptance merely because the street was used by its residents, since acceptance presupposes an option or choice to reject or accept, and neither the municipality nor its citizens could be held to the consequences of an acceptance because the street, in its improved state, was not abandoned.

CITY'S POWER TO PURCHASE ELECTRIC ENERGY

In a broad analysis of the term it can hardly be disputed that electrical energy as manufactured and supplied for public and private use is property. Electricity is rather an intangible asset, and the word "property" is perhaps not the most apt word by which to describe the supply of electrical energy thus sought to be acquired for the use of the city. However, if it was a water supply to be delivered from without to the mains of the city's distributing system, it might appropriately be so described, and an electric current to be delivered at the main conduit of the city's electrical distributing system is not essentially different. Therefore the California Supreme Court holds, Miller v. Los Angeles, 197 Pac. 342, that a provision in the city charter, empowering it to acquire, by purchase or otherwise, all property necessary or convenient to furnish the city and its inhabitants with light, heat and power, even if such provision is to be strictly construed, authorizes the city to make a contract for the purchase of electric energy sufficient to supply its inhabitants, even though the energy is not, strictly speaking, property.

CITY'S RIGHT TO DETERMINE PRICE OF IMPROVEMENT

If a city council and a board of supervisors may determine what improvements are calculated to advance the public interest, subject to interference by the courts only, when it is plainly apparent that such improvements are not so calculated, it must necessarily be true that they may determine what price shall be paid for these improvements, subject to no greater right in the courts to interfere. Los Angeles County v. Dodge (Cal. App.), 197 Pac. 403.

EFFECT OF NOTICE TO CITY BY PARTNER NOT TO DELIVER WARRANT TO OTHER PARTNER

The Pennsylvania Supreme Court holds, Markee v. City of Philadelphia, 113 Atl. 359, that where two partners of a firm which had a sewer construction contract with the city each notified the city not to deliver a warrant for money earned under the contract to the other partner, and the city withheld the warrant, the partners and the firm were estopped to claim that the city could have safely delivered the warrant to either partner, and they could not recover from the city damages caused by their failure to complete the work for lack of money. The city had nothing to do with the disputes of the partners, and was not obliged to decide between them, and by paying to one possibly become a litigant with the other.

EFFECT OF FAILURE TO APPEAL FROM DISALLOWANCE OF CLAIM FOR DAMAGES FOR ESTABLISHMENT OF ROAD

Where a road is established by a board of county commissioners, and a landowner presents a claim for damages because of the establishment of the road, which is not allowed, and no appeal is taken by him from the order, his right to claim damages is then ended, and the board of county commissioners is without authority thereafter to allow his claim of damages.—Zahn v. Board of County Commissioners, Kansas Supreme Court, 196 Pac. 1060.

NEWS OF THE SOCIETIES

August 29-30—INDIANA BUILDING TRADES COUNCIL, Hammond, Ind. Henry Gabler, Secretary, 436 Sumner st., Hammond, Ind.

Aug. 30-Sept. 1—MICHIGAN STATE GOOD ROADS ASSOCIATION. Annual meeting. Flint. Mich.

Sept. 2-3—MONTANA ASSOCIATION OF ARCHITECTS. Billings, Mont.

Sept. 6-10—INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Colorado Springs, Colo. Secretary, C. R. George, Houston, Texas.

Sept. 12-17—NATIONAL ASSOCIATION OF SANITARY ENGINEERS. Evansville, Ind.

Sept. 12-26 — AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS. Wilkesbarre, Pa.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 14-15—ASSOCIATED BUILDING CONTRACTORS OF ILLINOIS. Semi-annual meeting. Danville, Ill.

Sept. 19-21—ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA. Chicago, Ill. Secretary, P. J. McAndrews, C. & N. W. Ry., Sterling, Ill.

Sept. 19-23—INTERNATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONER. Chicago. Secretary, Ethelbert Stewart, U. S. Bureau of Labor Statistics, Washington, D. C.

September 19-24 — ASSOCIATION OF IRON AND STEEL ENGINEERS, La Salle Hotel, Chicago, Ill.

Sept. 26-30—ILLUMINATING ENGINEERING SOCIETY. Rochester, N. Y., Illuminating Engineering Society, Chicago Section, Chicago with National.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventth annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 5-7—SOCIETY OF INDUSTRIAL ENGINEERS. National convention. Springfield, Mass.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

AMERICAN ASSOCIATION OF ENGINEERS

A meeting of representatives of eight Indiana chapters of the American Association of Engineers for the purpose of organizing a state assembly or Indiana branch of the national organization has been called for August 29 by R. C. Yeoman, chairman of the state assembly committee of the American Association. Mr. Yeoman has requested the chapters of the association at Gary, Logansport, South Bend, Terre Haute, Valparaiso, Purdue and Angola as well as the local chapter, to send representatives to the meeting.

It is expected that the organization of the state assembly will include the establishment of permanent offices of the state association in Indianapolis in the charge of a paid secretary. It is possible that the state offices of other organizations of technical men may occupy the same general headquarters. The association has 700 members in Indiana.

CONFERENCE OF STREET CLEANING OFFICIALS

The International Association of Street Cleaning Officials held its second annual conference August 10, 11 and 12 in Chicago. The program announced included:

Possibility of establishing I. A. S. C. O. uniform cost-keeping form.

Garbage, ash and rubbish collection. a. Fly extermination. b. Savannah's incinerator experience. c. Disposal: 1. Hog feeding. 2. Incinerator. 3. Reduction plant. d. Contract or municipal. e. Receptacles. f. Equipment used. g. Frequency of service. h. Separation.

How are complaints handled? a. Plans used in subdividing work.

Sewer and catch-basin cleaning.. a Removal of roots from sewers. b. Huntington's experience with Victor self-propelling nozzles

Snow removal. a. Chicago's experience in snow removal work.

Street cleaning. a. Flushing. 1. Automobile, double or single unit. 2. Horse-drawn. 3. Hand-hose. b. Sprinkling. c. Hand brooming. d. Machine sweeping. 1. Sand spreading in connection therewith. e. Disposal of street sweepings. f. Personnel. 1. Wages—will there be a reduction? 2. Uniforms.

MICHIGAN BOARD OF EXAMINERS

The Michigan State Board of Examiners will meet for the registration of engineers, architects and surveyors at University of Michigan, Ann Arbor, September 14-16, for blanks and full information address Room 420 North 508 Griswold street, Detroit, Mich.

SOUTH CAROLINA GOOD ROADS ASSOCIATION

This association was recently organized at Columbia, S. C., for the purpose of "pulling the state out of the mud." A publicity and educational campaign is proposed to create a popular demand for good roads.

INTERNATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONS

The eighth annual meeting of the International Association of Industrial Accident Boards and Commissions will be held at the La Salle Hotel, Chicago, on September 19-23. The program will open on Monday morning when the president will deliver his annual address, Henry D. Sayer will talk on "Administrative Reorganization and New Methods in New York," and discussions will be heard on new legislation in several states. On Monday afternoon the addresses of welcome will be delivered at one session, and at another held at the same time the topic will be "Admin-

The municipal auditorium at Santa Monica, Cal., is nearly completed for the use of the municipal convention to be held there September 27-30, arrangements for the municipal expositions are in charge of W. H. Parker, commissioner of public works, Santa Monica

PERSONALS

Becker, William C. E., has been appointed chief engineer of the Department of Public Safety of St. Louis.

Grant, J. A., is now engaged in hydraulic design work on the reconstruction of works in Pueblo, Colo.

Lippe, Ernest V., consulting mechanical engineer, has established an office at 108 South La Salle street, Chicago, where he will continue his engineering practice.

Keith, Grover, mechanical engineer with the Victor Chemical Works, Chicago Heights, Ill., has resigned to accept a position with the United States Gypsum Co.

Quinney, Elwin, is now resident engineer with the South Dakota State Highway Commission in charge of the construction of state and federal aid roads in Deuel and Codington counties. His headquarters are at Watertown.

Mosher, Edward, has been appointed town engineer, Westfield, N. J., and will have charge of the construction and maintenance of roads and sewers and the operation of sewage disposal works.

Samms, Virgil W., has been appointed surveyor-general of the state of Idaho.

Crocker, Herbert S., has opened an office in Denver, Colo., where he will specialize in design and superintendence of construction of bridges, foundations, buildings and public utilities.

Sours, E. E., has been appointed road engineer for Allegan county, Mich.

Stone, Dr. W. E., president of Purdue University, Lafayette, Ind., was killed on Mount Eon, Alberta, Canada, on July 27, when he was trying to rescue his wife from a ledge on which she had fallen.

Logan, W. L., Council Bluffs, Ia., was drowned in the Missouri river July 1.

Hewes, Charles E., has accepted a position as city manager of Long Beach, Cal.

Hewes, Charles E., has resigned his position as city manager of Alameda, Cal.

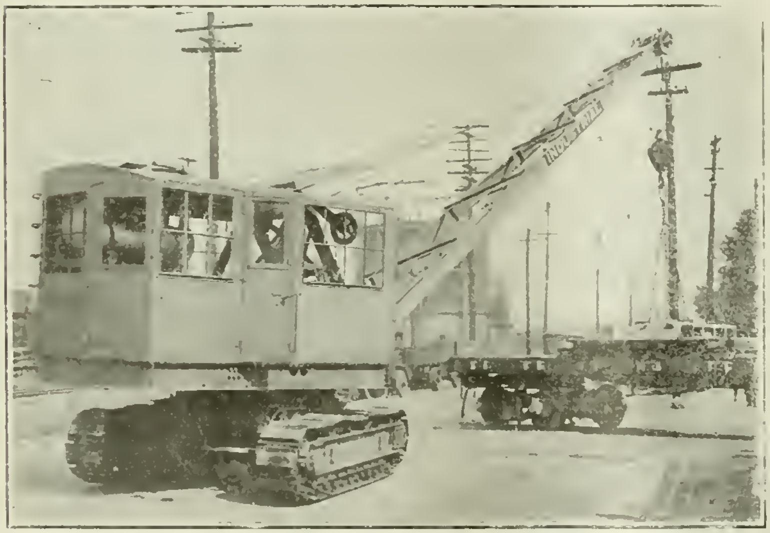
Ewart, David, for many years chief architect of the Federal Public Works Department, died at Ottawa on June 7 at the age of 80.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

FULL REVOLVING INDUSTRIAL CRAWLING TRACTOR CRANE

The Type BC "Industrial" crawling tractor crane, manufactured by the Industrial Works, has been developed to meet the need for a full-revolving tractor crane which can be operated independently of rails. The crane is built in two types. Type BC with a capacity of 20,000 pounds at 12 feet radius is equipped with continuous crawling tractor belts. Type BT with a capacity of 18,000 pounds at 10 feet radius is equipped with four broad-gauge tractor wheels.



INDUSTRIAL CRAWLING TRACTOR REVOLVING CRANE

These cranes, backed by half a century of crane building success, are pre-eminently adapted to the needs of contractors, road builders, gravel, sand and stone producers, and others. The capacity and speed of these cranes make them ideally suited for doing such jobs as moving coal, sand, gravel, etc., and for excavating duty. Within the limits of their capacity they will serve with the same efficiency as the railroad crane.

They can be equipped to handle a hook and block, grab bucket, drag scraper bucket, wood grapple, electric lifting magnet, shovel dipper and pile driver leads with drophammer.

Operation is by means of an internal combustion engine which has the advantages of being always ready for immediate use. When not in operation no fuel is consumed and it is not necessary, as often with a steam operated machine, to have a licensed engineer as operator.

The utmost care has been used to combine the necessary strength with the light weight essential to a tractor crane. Convenience in operation and maintenance have been provided to the highest possible degree.

The crane is equipped with 30-foot structural steel boom. The steering is accurately controlled by the operator from his position in the revolving upperworks, by manipulation of the friction clutches and brakes for each tractor belt. By means of which either tractor belt can be instantly disconnected from the motor while the other belt continues traveling at the normal rate of speed.

The disconnected tractor belt can be held stationary by applying the brake, can be allowed to coast with the brake and clutch both disengaged, or the clutch can be allowed to slip, thus allowing operator to turn as sharp or as wide a corner as he may select. All the clutches, brakes and lever mechanism for steering are located in the revolving upper works where the mechanism is simpler and more accessible than when a portion or all of it is located on the car body.

The propelling and steering mechanism is a new and exclusive feature of this crawling tractor crane. It enables the operator to propel and steer the crane, independently of all other motions, as easily as a wheel or "caterpillar" tractor.

WEBB CITY PORTABLE CRUSHING OUTFITS

The stone crushing outfit, made by the Webb City & Carterville Foundry & Machinery Works, has an all-steel stone crusher with a capacity of 6 tons per hour of stone crushed to 2-inch size, mounted on a steel truck that is also equipped with a folding bucket elevator that can be collapsed by a worm and chain gear to fold back over the top of the crusher and reduce it to sufficient clearance for highway transportation. The feeding platform is only 48 inches above the ground. The machine is easily fed and is adjusted by a well-protected hand wheel. The approximate horsepower that is required for the different sizes of machine are 12, 14 and 16 and the crusher can be equipped with portable screens and bins that make it complete and convenient for road construction operations.

THE MICHIGAN, JR., GRAVEL SCREENER AND LOADER

A machine that will take the gravel out of the pit or pile, screen out the sand and stones, and load the gravel into wagons or trucks.

It runs, by its own locomotive gear, up and down the side of the pit or pile on a track and takes off a 4-foot slice each time. It is self-contained and has an attachment on the screen that prevents it from clogging up with clay, clods, etc.

The loader delivers the screened gravel next to the machine, and the sand and stones separately twenty feet away where they will not have to be moved, thus saving $20 to $30 expense per day.

It is of simple all steel construction. Under ordinary conditions, three men operate it. It has an elevating capacity of one yard per minute.

INDUSTRIAL NOTES

The Canadian Chicago Bridge & Iron Company, Limited, of Bridgeburg, Ont., and Montreal, Quebec, has changed its corporate name to Horton Steel Works in honor of the late Horace E. Horton, who founded the organization in the United States in 1865. The Canadian organization was first incorporated in 1913 and the plant at Bridgeburg, Ontario, was constructed in that year.

THE RANSOME CONCRETE MACHINERY CO.

The Ransome Concrete Machinery Co. has recently shipped the third 21-E paver to the Tri-State Construction Co. at Bridgeton, N. J., who will soon have all of them in daily operation on one large job. The Ransome factory at Dunellen, N. J., is working constantly on these 21-E pavers and to date has not been able to get ahead of the orders.

The Ransome Co. has brought out this year a new 10-E Bantam type paver, and are shipping one this week to the city of Chicago. This type paver is particularly attractive for municipal work.

The New Orleans office of the Southern Cypress Manufacturers' Association is now located in the Poydras building, 507 Carondelet street, New Orleans.

The Consolidated Expanded Metal Company, Braddock, Pa., has established a new office and warehouse carrying a complete stock at 537 West 35th street, New York City, in charge of Thomas R. Herbert, Jr.

Yeomans Brothers Co., 1433 Dayton street, Chicago, manufacturers of centrifugal sewage ejectors, Shone pneumatic sewage ejectors and drainage pumps, announces the following representatives: P. E. Fallon, Gazette building, Little Rock, Ark., and Morton McI. Duckart & Co., McComas and Race streets, Baltimore, Md.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 SEPTEMBER 3, 1921 No. 10

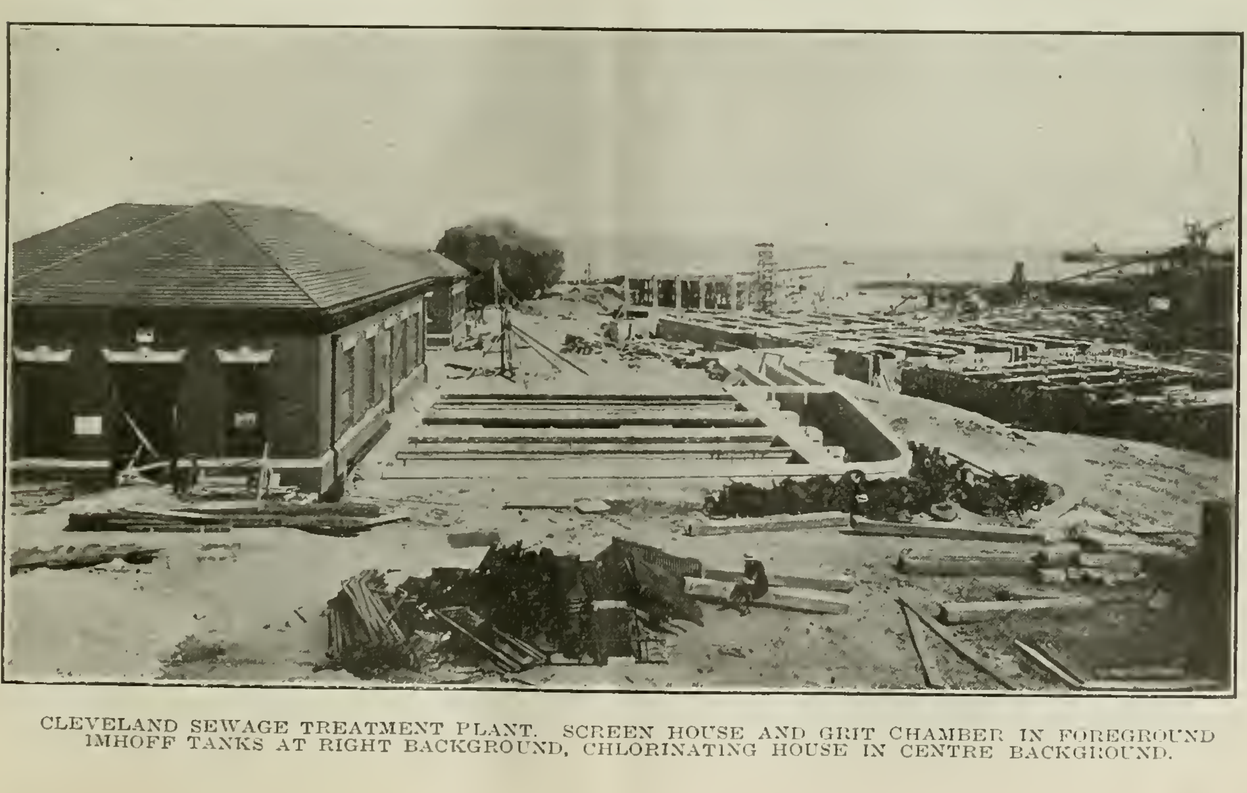
Cleveland Sewage Treatment Plan

This plant, now nearing completion, comprises novel grit chambers and thirty-two Imhoff tanks, and all effluent will be metered and chlorinated. The construction methods also include several novel features.

Cleveland discharges its sewage into Lake Erie, either directly or into the Cuyahoga river near its mouth into the lake. The new water works intake crib is located about five miles from shore opposite the western portion of the city. Most of the movement of the lake water is toward the east but in spite of this there is more or less danger of polluted water reaching the intake. In addition to this danger, there are parks and bathing beaches along the shore and because of these and other uses of the shore front a treatment of the sewage has long been recognized as being desirable. Experiments in sewage treatment were begun in 1913 and about $150,000 has been spent on them. Contracts for the two lake front disposal plants were made in 1919 and these plants will probably be ready for operation by the early part of 1922.

DESIGN OF TREATMENT PLANTS

For sewerage purposes, the city was divided into four districts known as the easterly, westerly, southerly and low level. The two plants now under contract serve the easterly and westerly districts, respectively. As it is expected to make radical changes in the Cuyahoga river, and as most of the sewage in the low level district, which lies along its banks, is trade waste, the resident population being small, the sewage from this and the relatively small southerly district will not be treated at the present time. Ultimately this sewage, which will be discharged into the river, will probably be treated more completely than is be-



CLEVELAND SEWAGE TREATMENT PLANT. SCREEN HOUSE AND GRIT CHAMBER IN FOREGROUND IMHOFF TANKS AT RIGHT BACKGROUND, CHLORINATING HOUSE IN CENTRE BACKGROUND.

ing provided for by the easterly and westerly treatment works which are located on the shore of the lake and discharge their effluents directly into it.

The populations used in designing the plants were 288,000 for the westerly plant, 575,000 for the easterly, and 226,000 for the southerly. The estimated sewage flow per capita is 125 gallons daily for the westerly district, 160 gallons in the easterly and 110 gallons in the southerly. This will give normal dry weather flows of 36,000,000 gallons a day, 92,000,000 gallons and 25,000,000 gallons, respectively. Provisions are made for wet-weather flows of 159,000,000 gallons in the westerly plant, about one billion gallons in the easterly and 131 million in the southerly.

The general features of both the easterly and westerly plants are practically the same, although the tank structures for the easterly plant are omitted for the present, and a description will be given of the westerly plant only.

Sewage is brought to this plant by an intercepting sewer with a maximum capacity of about 850 million gallons a day. The city is sewered on the combined plan, with many overflows of the weir type permitting the discharge of surplus storm water into ravines, the river or the lake.

The dry-weather sewage reaching the plant will enter it through a central channel in which are placed two bar screens set at an angle of forty-five degrees with the vertical, one of them having 1½-inch spacing between bars and the other three inches.

On each side of this channel are two others for carrying diluted sewage in times of storm. These other channels also are provided with bar screens and also with grit pits for intercepting the heavy suspended matter. The central or sewage channel has no grit pit and has on each side an overflow weir placed at such an elevation that when the flow exceeds a rate of 100 million gallons a day, the surplus will flow over these weirs into a bypass which will carry it directly to the outlet.

The grit pits differ from probably every other design for such structures. In each channel there are two pits, each eight feet long by three feet nine inches deep and separated by seventeen feet of channel. The nineteen feet of channel immediately above the first pit slopes toward the pit and the eight feet of channel beyond the second pit slopes up from it. It is believed that grit deposited along the channel will be carried by the current into the grit pit, being aided by the sloping floor, and that in the meantime it will be cleaned of any adhering organic matter. It is especially desired that the grit collected be clean enough to be inodorous, so that it can be used as fill without offense. It has been found from experiment that to meet this condition it must contain not more than 15 per cent of organic matter. It is probable that some of the finer mineral matter may be carried through the grit chamber and into the sedimentation tanks but provision is made for removing such deposits from the sludge hoppers, should they occur, by pumping.

Each channel is calculated to have a capacity of from twelve to twenty-four million gallons a day with velocities of one-half to one foot per second. The over-all length of each grit chamber is 50 feet. In order that the attendant may be facilitated in throwing into operation additional grit chamber channels when the amount of storm flow may make it desirable, these are controlled by large hydraulically operated sluice gates. Should it later be thought desirable, these can be arranged to be operated from a central switchboard.

From the grit chambers the sewage passes through sedimentation tanks of the two-story or Imhoff type. First, however, the sewage enters an equalizing chamber which is provided with partition walls for distributing the flow to the various batteries of tanks. For the present, stop planks will be used for regulating the flow. From the several distribution channels, the sewage will be distributed to the tanks, the channels being arranged so that flow in the tanks can be reversed at will. Just before entering the tanks, the sewage flows into a small entrance chamber where its velocity will be reduced. It leaves this chamber through a submerged orifice, this construction being expected to collect some of the grease and other floating materials in this chamber rather than permitting them to flow on into the sedimentation tanks. Adjustable weirs are placed in the inlet openings to each entrance chamber in order to accurately control and measure the amount of flow to each tank.

There will be thirty-two Imhoff tanks arranged in four rows of eight tanks each, the several rows being separated by three galleries. Between the first and second and between the third and fourth rows, the gallery will contain a sludge channel. In these galleries also will be located water piping, valve handles and other apparatus. The bottom of the flow channel serves as the roof of the pipe gallery. Each of the thirty-two tanks is 50 feet long and 25 feet wide, and contains two hoppers. The water will have a depth of 27 feet and the tank walls rise two feet above the water level. They are designed for a detention period of one hundred minutes with the 1930 population or about 2½ hours with the present population. Each flowing-through channel has a "V" shape or double-sloped bottom with a slope of one and one-half on one and a slot eight inches wide between them.

Each tank has a gas vent nearly its full length in the center of the tank. These vents are to be covered with hinged wooden doors in order to minimize the possibility of odors, because of the location of the plant adjacent to a park and well-traveled boulevard. Should there be an excessive amount of foaming, the scum can be drawn off through an opening in the end of each gas vent. The bottom of each hopper comes directly under the gas vent and eight-inch sludge pipes rise vertically from the hopper bottoms through the gas vents, providing for rodding the pipes in case of stoppage. Each discharges into a horizontal branch 7½ feet below the water level which is supported in the cross wall of the sedimentation tank and discharges into a main which leads to the sludge channel. Each sludge channel leads to a sludge well which has a storage capacity of about five hundred cubic feet and from which the sludge will be pumped by a centrifugal pump or ejector.

In each sedimentation tank there is a cross wall for stiffening the tank and supporting the sloping bottoms of the upper sedimentation chamber, the gas vent walls and the sludge pipe. These cross walls do not extend to the bottom of the tank but are provided with an arch in their bottom edge, thus minimizing the separation of the bottom or sludge compartment of the tank. The sloping bottoms of the flowing-through compartment are built of hyrib metal supporting a three-inch slab of concrete applied by the cement gun.

Each gallery between the sets of Imhoff tanks will contain water mains from which pipes will be carried to each tank, feeding a pipe grid which will be placed around each hopper bottom to be used in flushing off the sludge; also a two-inch pipe will run to the bottom of the hopper for softening up the sludge in order to start the flow of sludge into the sludge pipe. Water pipes will also be carried to convenient points and furnished with hose connections by means of which water can be used for wetting down the scum, washing the plant and other purposes.

The tanks are designed with a scum capacity of 0.6 cubic feet for each person and a sludge capacity of 1.2 cubic feet. This is expected to provide sludge storage for 5.7 months ultimately or 8.5 months with the present population.

It is proposed at first to pump the sludge into barges which will carry it out northeast into the lake about three miles to a government dumping ground, where dredgings from the Cuyahoga river are deposited. If it becomes necessary to discontinue this disposal, provision is made for sand beds for receiving the sludge along the shore of the lake.

Leaving the Imhoff tanks, the effluent will pass through a Venturi meter and then through a chlorinating well where chlorine is to be applied at the rate of ten parts per million. Connected with the Venturi meter will be appliances for controlling the quantity of disinfectant applied, which application will probably be by means of standard chlorine machines of the solution feed type. These chlorine pipes together with pipes for steam heating, water, etc., will be carried in a pipe gallery laid under the ground surface and connecting the house which contains the Venturi meter and chlorinating apparatus to the building at the entrance of the plant where a steam boiler for heating purposes and an incinerator for burning screenings will be located, the screenings being first passed through a press of the cider mill type for removing superfluous water.

The effluent, after being disinfected, will pass through an outfall with multiple outlets, which was described in our issue of February 26, 1921, and which has for some time been carrying the sewage of this district.

CONSTRUCTION

In constructing this plant, the area was first enclosed by steel sheet piling about 250 feet on each side. This was driven down about 18 feet, the bottom being several feet in soft blue clay. Owing to the tightness of the sheeting and the clay bottom, very little water enters the enclosed area, two 2-inch centrifugal pumps electrically operated being more than capable of handling the seepage. The sheet piling is not braced from the inside but heavy wooden piles are placed just inside of it at intervals and these piles tied back by long steel rods to anchor piles driven solidly into the ground outside of the enclosure.

The bottoms of the sedimentation tanks were excavated 15 to 18 feet deep and were in the blue clay referred to. This gave a solid support and no piling was used. It was found, however, that the clay was very slippery and sticky and made it difficult for the workmen to surface it to the desired lines and to maintain it there while placing the concrete bottoms of the hoppers, at least without working more or less of the clay into the concrete. For this reason, after shaping the clay bottom, a 3-inch concrete bottom was laid and allowed to set. This concrete floor provided a dry and clean platform on which to work and to place the concrete hopper bottoms and the contractor found that the cost of this concrete working floor was less than that incurred by having the men working in the clay; in addition to which this construction made it possible to secure absolutely clean concrete. The concrete hoppers were all built in forms rather than being surfaced by hand, this also not only giving better results, but being considered by the contractor to be the more economical method. All of the tank bottoms have been completed and are apparently perfectly water-tight.

The concrete for the bottoms and heavier side walls was placed by means of tower and chutes, Lakewood mixers, tower and chutes being employed. The minimum grade of chute used is about three horizontal to one vertical and although the concrete is mixed as wet as is frequently found necessary for the chuting, it is very seldom necessary for men to assist the flow of the concrete in the chute by hand. In pouring the concrete for the thinner walls in the tops of the tanks it is thought by the contractor to be more economical to use concrete wheelbarrows, which are filled by chutes reaching various parts of the plant and carried to the exact point of application on running planks. The continual changing of the position of the end of a chute when pouring a thin wall is believed to be more costly in delays and hours of labor than the method in use.

The concrete throughout seems to be unusually sound and of good surface. Some of the older concrete which was completed almost a year ago is standing with no appearance of deterioration, such as checking or surface disintegration. Exposed surfaces are covered with wet bags or other materials for at least a day or two after pouring, the length of time depending upon the weather. On removing forms, the green concrete surfaces are rubbed down with a wet brush and a smooth surface is thus obtained on all exposed concrete.

All concrete is made abundantly thick for safety. Reinforcement is used practically everywhere. Where the strength does not theoretically require it, reinforcement is used to prevent temperature or other cracks or on general principles.

An abundance of valves are used on all pipe lines and of stop planks in open channels, on the general principle that the construction of the slots for such planks costs practically nothing during construction but would be expensive to cut out should they be needed at any time later.

The construction of this plant is in immediate charge of J. M. Heffelfinger, senior assistant sanitary engineer of the Department of Public Service. The work is being done under the Department of Public Service, of which Robert Hoffman is chief engineer. The design and construction are under the supervision of George B. Garcoigne, sanitary engineer in charge of the Subdivision of Sewage Disposal.

The contract for the western disposal plant was let to Masters & Mullen Company, of Cleveland. The estimated cost is $1,000,000.

The Berlin Turnpike

Eight miles of macadam road in Connecticut reconstructed with 22-foot concrete roadway for $490,000 on cost plus 10 per cent basis.

Occasionally when the Connecticut State Highway Department is unable to predetermine all of the conditions and requirements for a road construction job, especially when traffic must be maintained and it is difficult to foresee what regulation will be best for it, and when the state wishes to maintain control of the details, to make changes as the situation develops and to modify the original plans, it frequently executes the work on the cost plus percentage basis.

In cases where it is not practicable to prepare a satisfactory specification in advance that will cover all of the conditions, it is customary to make a contract for the performance of the work, by which the contractor will furnish plant, equipment and supervision and will hire the labor, and the state will pay all bills for labor and material and other necessities outside of machinery, equipment and supervision and will in addition pay the contractor 10 per cent of the total amount of the state's preliminary estimate of the construction cost as his profit for superintendence and use of equipment.

This affords the state opportunity to develop the plans as the work progresses and in accordance with changing conditions; enables it to increase or decrease various amounts and to take complete control of the details and operations without injustice to the contractor and without incurring costs for damages or increased charges for extras. At the same time it is able to make any economies that the conditions warrant or to make extensions on the basis of the actual cost incurred, so that by strict supervision and accurate bookkeeping, an opportunity is afforded for modifications that are advantageous to the state and still insure a predetermined compensation to the contractor without subjecting him either to danger or loss through conditions beyond his control or affording him an opportunity to make excessive profits.

This arrangement assumes that the contractor has abundance of suitable equipment and is vigorous, efficient and trustworthy in his execution of the work, which should, in addition, be minutely and continually supervised by the state engineer and auditor. In this way the state practically insures itself against unforeseen conditions, reaps the corresponding reward for unexpected advantages and wholly eliminates the gambling principle found in the fixed sum or unit price contract arrangement.

The Berlin turnpike, a 22-foot concrete road about 8 miles long, was built for the State Highway Department by the Edw. Balf Co., of Hartford, and the Lane Construction Corporation, of Meriden, on the cost of plus 10 per cent basis for about $490,000. The 10 per cent fee was computed on the cost estimated by the Highway Department and accepted by the contractors. When the road was completed it was found that the actual cost of the construction, exclusive of the contractors' fee, was about 10 per cent more than the department's preliminary estimate, due large-

TRAP ROCK STORAGE PILES

FINISHING SURFACE OF CONCRETE BY MACHINE ly to delays in securing materials, especially cement as required during the progress of the work and to some extent to labor shortage and inefficiency.

Conditions were favorable to the execution of the work in that it was practicable to divert all traffic to a parallel road so that construction operations could be carried on without interference along the entire length of the route. The job was the reconstruction of a macadam road that had been built about 12 years previously and consequently needed little additional grading.

METHOD OF CONSTRUCTION

In general, the old macadam was first scarified by an attachment operated on the rear of the steam roller and the broken stone was distributed with scrapers and compacted by steam rollers to make the foundation for the concrete surface.

The work was divided into four sections, executed by as many different parties, two of which commenced at the center and worked toward the ends where the other two commenced, meeting and completing the work at the quarter points of the entire length. Nearly all of the foundation work was done with the steam rollers and scrapers, no team work being required except for long hauls on fills. About $75,000 was expended in extensions and improvements of the original drainage system.

The sand, which was hauled 13 miles, and the broken stone and cement were all delivered by trucks and the aggregate stored in piles during the winter previous to the execution of the work, and when the latter was commenced, loading machines at the piles served the trucks by which the materials were distributed along the location just ahead of the concrete mixer, trucks being used for this purpose because the grades were too steep for the installation of an industrial track.

The contractor installed a 2-inch main the full length of the roadway and through it delivered water from various successive sources of supply to the mixing machine and for other purposes required. The concrete surface, 22 feet wide, was laid at a record speed of 800 feet per day and toward the close of the work the progress averaged about 1 mile per week.

PLACING AND FINISHING CONCRETE

Contra Costa County's "Safety" Highway

The county engineer of Contra Costa county, California, R. R. Arnold, in 1919 laid an experimental quarter-mile section of a two-track highway that has proved so successful that the county has built twenty miles of similar construction on the highway between Martinez and San Ramon, and has completed altogether about 35 miles, with 7 more under construction.

This type, which has been called the "safety highway," is constructed of two strips of concrete pavement each 8 feet wide, separated by a 4-foot strip of oil-bound macadam, and with a 2-foot shoulder of the same material on each side. The central strip is raised 1½ inches above the level of the concrete pavement, which encourages the traffic to keep on its own side of the road, although the central strip can be used for passing a vehicle going in the same direction. This tends to prevent collisions. The black central strip affords such contrast with the light concrete that they can be distinguished at any time.

The slabs are made five inches thick, which is believed to be sufficient for such a narrow roadway, thus saving in cost. The longitudinal cracks that appear in wide concrete pavements are avoided, and no reinforcement is necessary. Mr. Arnold's figures show that the double slab type of road with shoulders costs $2,000 per mile more than an 18-foot pavement 5 inches thick without shoulders, and $700 less than such pavement with 2-foot shoulders.

An additional advantage is that traffic can use one side of the road without interruption while the other side is being constructed.

LOOKING BACKWARD FROM MIXER TO ROAD IN THE BACKGROUND PROTECTED BY COVERS

Important Wage Reduction

The United States Steel Corporation has officially announced that on August 29 the wages of mill laborers in general will be reduced to $.30 an hour and that other wages and salaries will be equitably adjusted. Following the 20 per cent reduction of May 16 by the same corporation this effects a total reduction of about 34.8 per cent from the post-war peak rate of $.46 an hour in effect previous to last May, besides which the war-time arrangement of time-and-one-half pay for overwork was eliminated on July 16.

The decision of the United States Railroad Labor Board abolished the time-and-one-half rate to men assigned to necessary Sunday and holiday employment when the work requires continual performance seven days a week, and the men are regularly bulletined for it. This is the first rule prescribed by the labor board to replace the national agreements established during federal control, and applies only to the 137 railways involved in the overtime controversy with the six federated shop crafts, but will bind all other roads as soon as their cases come before the board. Railroads having independent agreements with their employees will, however, be exempted from the rule.

In explanation the board announces that "the soundness of the principle of punitive pay for overtime work has been recognized, but not to the extreme extent embodied in the national agreement. The 8-hour day has also been given full recognition. . . . If men are called after regular hours for some emergency work it is fair and reasonable to use these men only on other emergencies, which may have developed since they were called, without being obliged to call them again or to call other men. . . . It is just and reasonable that men assigned to road service on a monthly basis should be paid on an 8-hour day, 365 days per year, without any allowance for overtime."

The statement accompanying the rules calls attention to the fact that the wide diversity of rules among the numerous railroads of this country before federal control, makes it possible to cite precedent for almost any rule that may be advocated and that such precedents are at best only persuasive, should not control, therefore the board has not considered the principle of right and wrong involved in the proposals and counter proposals submitted to them in the light of present conditions and industrial history. The action of the board was opposed in a minority report by the former president of the American Federation of Labor, who is one of the three labor representatives on the board. He objected to the decisions against "conditions that have been in effect from ten to twenty years," and, among other objections specified that under the new rules employees called for work and not working, or working 2 hours and 40 minutes or less, will receive four hours' overtime instead of five; and that instead of 5 hours pay the employees called one hour or less before their regular time will receive time and one-half for the overtime.

Town Planning

Town planning and its relation to the improvement of the capitol of the Diminion of Canada were discussed at length in a somewhat poetical and academic address urging the creation of a federal district to include the cities of Ottawa and Hull, that was made before the special Senate Committee by Noulan Couchon, chairman Ottawa town planning commission, whose remarks tended to the ethical and sociological aspects of town planning in general, and included some practical definitions of important principles.

He said, in part:

. . . The ethical raison d'etre, the justification of town planning, lies in the injunction to society, collectively no less than individually, to fulfil the Golden Rule. The injunction to "Do unto others as you would that they should do to you" imposes the abolition of the slum, be it of over-crowding in the city or of isolation in the country.

The crux of the problem in the complex of modern civilization is to determine the use and development of land and to obviate congestion, which is primarily a matter of so adjusting inter-communication, waterways, railways, highways and social intercourse as to afford freedom in exchange of the products of the energy and mind of man.

Town planning in theory and in practice is the technique of sociology, it is the professional application of knowledge for social betterment.

Planning aims, through rapid communications, good roads, small holdings, coupled with the stimulating amenities of community life, to endow rural production with the power of attracting the tide of popular aspiration, of desire, from the city to the field, as the antithesis of hardship, isolation and the social disabilities of pioneering.

. . . The ethics of town planning enable a prophetic vision of the standards that must obtain for the race in ultimate resistance against the alien tide that may deny it supremacy—existence.

These standards must be sustained by work and play, by thought and the joy of living. Further, these standards must be guarded by a scientific sifting at our gates of the eager inflow of indiscriminate immigration. Elemental to survival is the exclusion of those who would underlive us to extinction.

. . . The proposal consists in vesting control of the physical features and public services of Ottawa and Hull and the surroundings of both, in the hands of a Federal District Commission, whilst leaving undisturbed the present political status—dominion, provincial, and municipal—in all that otherwise pertains to autonomy in civil and in criminal law.

Assessments, taxes and the distribution of these might remain provincially divided as at present, but be supplemented proportionately by the Dominion government in respect of those rates ceded to the commission by the municipalities.

As an instance, this advisedly, technical commission would do the planning and engineering work for both cities, spending their quota of taxes for such purposes in the respective provincial areas from which they were collected.

PUBLIC WORKS.

Published Weekly
by
Public Works Journal Corporation
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba. $3.00 year
All other countries .... $4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
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FRANK W. SKINNER, Associate Editor

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Progress in Wage Adjustment

The facts that more than 5,000,000 workers in the United States are now reported as being idle (because they or their fellows refuse to accept abundant work at reduced but still too high prices); that the last published official comparative data show that in the United States the wages of bricklayers were 6.8 times as great as in France with the ratios of carpenters, painters and plasterers not very much less, while common laborers received more than 5.7 times as much as in France; that the English bricklayers received only about 30 per cent of American wages, other mechanics a slightly greater proportion and laborers 52 per cent, while in all the other principal countries noted, all kinds of workers receive much less (in Germany and Austria the highest price quoted for mechanics of any kind was $.99 and for laborers $.53), all figures being based on the exchange value of American money; that production in this country is greatly retarded and vital improvements delayed by the high price and inefficiency of labor; that the reports are unanimous of increasing industry and efficiency abroad, particularly in Germany and France, where the work is intensive and a working time of 10 hours or even more per day is producing astonishing results; and that the costs of materials and supplies in this country have decreased much more than labor, and stocks of many raw and manufactured materials are running low—these fundamental facts are of the gravest national importance.

Under such conditions there can be no question of the necessity of adjusting wages promptly to a proper co-ordination with both comparative and intrinsic values, and to a competitive scale with the rest of the world.

Much encouragement is afforded by the action of the eastern, western and middle groups of railroads in refusing to cancel their recent necessary cut in wages at the insolent demand of the unions accompanied by a scarcely veiled threat of a country-wide strike and the wholly unreliable promise to refrain from additional demands in the near future, and by the strong attitude of the southwestern railroads that refused even to discuss the subject with them.

The statements on other pages of this issue, to the effect that the United States Labor Board has reduced some of the unwarranted over-payments to the railroad employees, and that the United States Steel Corporation has made an important horizontal cut are equally important and gratifying. The railroads and the steel manufacturers represent industrial and labor interests of far greater magnitude than any other single elements in this country, and their action cannot be over-estimated. Both of them have the merits of absolute fairness coupled with generosity, and it should be especially noted that very material privileges and advantages are still afforded to the railway employees above those in any other great organization, and that the steel makers have more than demonstrated their good faith by announcing heavy cuts in the prices of their finished products several weeks in advance of the wage decrease, and are showing every consideration for the workers.

It only remains for the workers to accept those conditions in a manly, progressive spirit and they can readily by concerted action, classification and increased industry secure so much greater efficiency that their remuneration will become greater than even under the inflated war wages, while the purchasing value is greatly increased by the lower costs of living thus made possible.

Settlement of Structures

Most engineering structures, unless supported on rock, hardpan or rigidly confined, dry, hard, loose material, like gravel or sand, are subject to more or less settlement, which may or may not be highly undesirable, but which certainly is increasingly dangerous and troublesome as it becomes uncertain and irregular. Many structures like bridge piers, abutments, retaining walls, roads, railroads, canal locks, dams and even the foundations for buildings and machinery may settle considerably without serious damage or inconvenience provided they settle uniformly and the settlement is anticipated in the design and construction, but the settlement is likely to be troublesome and sometimes exceedingly dangerous and costly if it is unexpected, irregular or shows very abrupt changes in amount or rapidity.

The settlement is due to many factors, principal among which are the character of the soil, the amount of water in the ground, the intensity of the static load, change of load, impact, vibrations, disturbance of adjacent soil and other local conditions.

Under some conditions a moderate amount of settlement may be of very little import. Under many more conditions it will be found not to be very serious if it is regular and especially if it is anticipated and provided for in the design and construction. In other cases it must be reduced to a minimum and great care taken to diminish or control it.

Settlement is usually greatest on very wet, muddy or compressible soils, or those that are not homogeneous and may vary from a fraction of an inch to several feet. It may be immediate, slow, rapid or delayed, limited or progressive. On the determination of as many as possible of the factors and their proper consideration depend the excellence of the design and the economy and durability of the structure. Much, and sometimes all, of these data may be obtained by a careful study of locality and investigation of neighboring structures, by subsoil explorations with borings and soundings, by actual loading tests of the soil, and by careful study and analysis of all the information collected.

Only meager data is available in text books and other ordinary references and there is at present an almost total lack of uniformity or standard classification or rules of practice.

As unsatisfactory foundations may and sometimes do, cause damage far beyond the original cost of the construction, good practice is of immense importance, and recognizing this fact, the American Society of Civil Engineers has appointed a special committee of experts to secure and arrange available data on this subject. The committee has commenced its labors by issuing a comprehensive questionnaire which has been mailed to the large membership of the society, asking simple specific questions, the answers to which will eventually be of great value. Every engineer or builder will do well to apply for a copy of the questionnaire printed on a standard size blank from which blueprints can be made, and record thereon all of the data that his own records apply. If it is sufficiently complete and accurate it would probably be welcomed by the committee, although the questionnaire is not addressed to strangers. In any event, the recording of such data whenever and wherever observed, will not fail to be of great value to every engineer, builder and contractor and the questionnaire will serve as an excellent guide for selection, classification and recording.

Building Up Secure Construction Conditions

In the present unsettled times, when all industrial and constructional interests are finding a new working level, the correction of recognized faults in all ordinary procedure and the improvements of many unsatisfactory conditions will contribute greatly to the stabilization of construction and to the amount of it that can be executed for all kinds of federal, municipal and other sorts of public works. Sound propaganda to effect this is embodied in the working program announced by the Associated General Contractors of America, excerpts from which are printed on another page.

Among the most important items are the establishment of national conference and arbitration boards: adoption of standards for accounting, contracts and classified costs; securing open sale of material on the market and fall lettings of public works; promoting legislation to secure a Federal Department of Public Works; a selective immigration law; adequate federal aid for highways; proper railroad regulation and an effective water power development act.

These objects are normal and worthy and most of them are urgent and should be universally supported by individuals and organizations directly and indirectly interested in public works.

Desideratums of Engineering Construction

Excerpts from the program of the Associated General Contractors of America.

Maintain the National Board for Jurisdictional Awards in the Building Industry.

Organize a National Conference Board for the Building Industry, representing contractors, workmen, architects, engineers, and owners to consider working conditions, establish national standards, remove restrictions, eliminate strikes.

Promote the organization of official and voluntary Boards for Arbitration of disputes.

Secure payment for estimating and quantity survey. Formulate standard estimating forms for builders and highway contractors.

Develop a system of money accounting for contractors.

Standardize construction cost accounting practices, such as equipment rental schedules.

Secure necessary amendments to existing Standard contract forms and formulate others.

Revise, systematize and standardize compensation insurance classification and rates.

Secure passage of national legislation, as follows: Navy, war, treasury contractors' relief bills, Department of Public Works bill, a scientific selective immigration law, adequate Federal Aid for highways, an effective water-power development act.

Proper railroad regulation, including: (a) Maintenance of private ownership, (b) curtailment of Interstate Commerce Commission's arbitrary power to grant priorities, (c) modification of war-time freight rates on construction materials, (d) adequate support of railroad expansion.

Standardization of government contracts.

Secure an open wholesale market in materials.

Urge fall lettings of highway and public works contracts.

Seek the standardization of building codes.

Bearing Value of Soils

Standard classification of sizes and character of soils and details of loading tests issued in questionnaire of committee of Am. Soc. C. E. to secure data for study and formulation of accepted practice.

The special committee appointed by the American Society of Civil Engineers to report on the bearing value of soils is composed of Robert A. Cummings, chairman, 221 Fourth avenue, Pittsburgh, Pa.; Walter J. Douglas, secretary, 84 Pine street, New York City; E. G. Haines, Allen Hazen, James C. Meem.

It has issued a circular letter to the members of the American Society of Civil Engineers which says, in part, that "the allowable load is, in most cases, determined by the question of settlement and the effect of such settlement on the proposed structure. It is obvious that for certain types of structures the settlement should be kept to an

QUESTIONNAIRE AND BLANK FORM FOR RECORDING DATA OF SOIL LOADING TESTS ISSUED BY SPECIAL COMMITTEE OF THE AMERICAN SOCIETY OF ENGINEERS

Record of test for settlement ...., or observation of actual settlement of structure ....

Contributed by .... Address ....

Date of test or observation .... Location...................................

Type of structure proposed or built ....

CHARACTER OF SOIL.

Committee's size grades, in millimeters. Give percentage of each if possible, if not, check prevailing size.					Common Class Index.*	Moisture.
Stones:	Coarse,	256.0	to	128.0	1....	Very dry
	Medium,	128.0	to	64.0	2....	Moist
	Fine,	64.0	to	32.0	3....	Wet
Pebbles:	Coarse,	32.0	to	16.0	4....	Saturated (below ground, water level)
	Medium,	16.0	to	8.0	5....	
	Fine,	8.0	to	4.0	6....	
Grit:	Coarse,	4.0	to	2.0	7....	Was the condition constant
	Medium,	2.0	to	1.0	8....	
	Fine,	1.0	to	0.5	9....	
Dust:	Coarse,	0.5	to	0.25	10....	or variable?
	Medium,	0.25	to	0.125	11†...	
	Fine	0.125	to	0.0625		
Flour:	Coarse,	0.0625	to	0.0312		
	Medium,	0.0312	to	0.0156		
	Fine,	0.0156	to	0.0078		
Powder:	Coarse,	0.0078	to	0.0039		
	Medium,	0.0039	to	0.0019		
	Fine,	0.0019	to	0.0000		

BEARING SURFACE

Position	Type	Loading
Depth below original surface in ft..	Test area	Constant ....
	Isolated pier......	
Depth below adjacent surface in ft..	Section of well...	Variable ....
	Pile footing.......	
Was it near any stream or other body of water?....	Single pile	Subject to impact ....
	Open pit	
If so, how near?..	Sheathed pit......	
How far above water below	Deep caisson......	Maximum total load ......lb.
Notes:	Area of bearing surface, sq. ft......	Load per square foot ....
....	Was surrounding soil restrained, as by buildings?.....	Notes:
....	Was friction a factor to be considered?	....
....	To what extent?...	....
....	....	....
....	....	....
....	....	....
....	....	....
....	....	....

Record of Tests or Observations of Settlement of Structures

Load per sq. ft., in pounds........	500	1,000	2,000	4,000	8,000	10,000	15,000	20,000	25,000
Settlement, in inches									
Total time interval									

---

* Class 1, Soft rock; 2, shale; 3, hardpan; 4, gravel; 5, sand and gravel; 6, coarse sand; 7, medium sand; 8, fine sand; 9, fine sand and clay; 10, clay.

† Class 11, Special or unlisted mixtures, check, and describe here: ....

NOTE: For tests, record total settlement and total time at each increase of load; for settlement of structure record total time and settlement only, unless still progressing. Use a separate sheet for each record. Record any other useful information on separate sheets and attach. Mail all records of tests or settlement to E. G. Haines, 49 Lafayette street, New York City.

absolute minimum, because such settlement, or at least unequal settlements in different parts of the structure, will cause physical damage. For example: if a highly ornamental cut-stone building settled unequally in different parts, it might be much disfigured and injured by reason of spalling or cracking. On the other hand, an elevated railway carried by independent piers may settle considerably at one or more of the bearings with no evidence thereof whatever, except as indicated by the grade of the track. Structures on pile foundations, particularly around harbor and river work, almost invariably settle, but usually they are of a type and designed so that a reasonable amount of settlement is not injurious.

"It is believed that the limit of allowable load should be based on some definite portion of that part of the compression diagram showing a practically uniform rate of compression with increase of load. The amount of such percentage should vary with the type and importance of the structure."

The committee feels that the question of actual settlement is one of the principal determining factors in the question of safe bearing values. To enable the committee to make recommendations as to the limiting amounts of such settlement for different types of structures and soils, it desires to obtain as many records as possible of actual settlement of soils subjected to loads, both in the case of tests made for bearing value and those of actual structures which have settled after completion, together with such descriptive matter relative to the soil, and other conditions, as will enable the committee properly to classify the different records. The accompanying form of questionnaire has therefore been prepared, and it is hoped that the membership will co-operate by supplying as many records of settlement as possible.

Testing the Bearing Value of Soil

The bearing value of soils may be considered as the permanent load per square foot, which it will sustain without material settlement after a period of a few months from the time of its initial application. It should be assumed for a static load under the most favorable conditions that are to be apprehended and may vary from a very few hundred to 10,000 or even 20,000 pounds. Whatever it is should be predetermined when the structure is designed, thus permitting in some cases the bearing value to be increased and in other cases the design to be modified if necessary so as to decrease the unit pressure or to supplement the bearing value by utilization of frictional resistance as in the case of a cylinder, pile or caisson foundation.

The bearing value may be tested by observations on the foundations of existing structures, by special loading, and by driving piles, by which it is possible to determine with considerable accuracy the capacity of the soil to sustain loads and thus calculate for the settlement which will occur under future loading. It is thus often permissible to build important structures on very yielding soil, as for example in Chicago, where many tall and heavy buildings have been designed to provide in advance of the settlement of a number of inches and the final settlement after the structure was completed and its full weight and that of its contents was imposed on the soil, agreed within a fraction of an inch with the original calculations.

A remarkable example of such calculations is afforded by the foundations of the very tall and heavy municipal building in New York, which is supported on more than 100 pneumatic caissons, of which more than one-half were carried down to solid rock while the remainder rest on a stratum of quicksand. The quicksand was carefully tested in advance and it was calculated would sustain a certain load with a certain amount of settlement, which was allowed for in designing the steel work and superstructure, which is now supported partly on rock and partly on sand without any material variation from the intended elevation and without any injury to the lofty superstructure.

In this case and in many others very accurate and reliable work is necessary on account of the delicacy of the structure or the necessity of preserving perfect alignment of mechanical installations, making it necessary that the settlement, if any, shall be made absolutely regular. In other cases it is immaterial as in a pile trestle or viaduct where any reasonable amount of settlement can be easily taken up by grading the roadbed above and is much more economical than providing a perfectly stable foundation. This is especially true for temporary work, such as falsework piling where the piles frequently settle several inches or even feet so that the diagonal bracing as well as the blocking on top has to be continually inspected and revised.

The settlement of existing structures is easily determined by making on them permanent reference marks and referring them periodically to permanent bench marks by which a record of settlement and progress is easily prepared.

Crude tests affording indications, sometimes merely negative, can be had by driving rods, stakes and piles. The latter should always precede the final determination of the number of piles for a foundation in a location that is at all uncertain. Careful bearing tests are ordinarily made in an excavation of convenient depth, or to the bottom of the general excavation required, where a horizontal, undisturbed surface is prepared to form a unit loading surface, preferably not less than 12 inches square, to which a measured load is applied. This is often done by bracing a vertical 12 x 12-inch timber of convenient length so as to prevent horizontal motion and not resist vertical motion. The top of this column supports the center of gravity of a symmetrical loading platform from 3 to 10 feet square on which a measured quantity of sand, gravel, brick, paving stone, pig iron or other regular heavy ballast may be applied without shock, continuously or intermittently. Indexes attached to each corner of the platform should at the beginning of operations register at zero on scales carefully fixed on the ground.

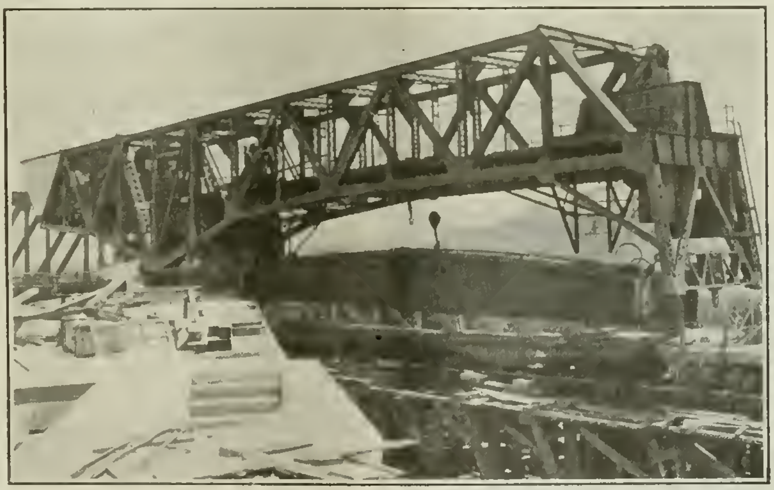
The load should be applied so as to form successive increments of 50 or 100 pounds per square foot of tested surface, and the positions of the indexes should be carefully recorded after the application of each load. An interval of seven hours or days may elapse before a second reading is made and another increment added, and so on, until the settlement becomes too rapid, and the load should be allowed to remain undisturbed for several days or weeks, when it is likely to settle with diminishing speed until it eventually comes to rest or shows very slight additional change. The maximum load which can be carried without rapid change may be considered as the practical ultimate bearing load of the soil, and it generally causes moderate brief settlement which should not be increased and it is generally roughly proportional to the amount of load.

The bearing value of the soil for a large pier is sometimes considered a direct multiple of that indicated by a one-foot square test, but the assumption is not necessarily jutified.

Handling 90-Ton Sections of Emergency Canal Dam

Steel 6½ x 8-foot girders up to 84¼ feet long unloaded from flat cars, rolled 90 degrees in steel rope slings, swung to position and deposited in storage.

Extraordinarily large and heavy box girders have recently been unloaded from the cars, shifted and conveyed to storage in the field in a rapid and convenient manner by the utilization of the permanent plant installed for the operation of the Inner Harbor Navigation Canal, New Orleans, without the necessity of using derricks, locomotive cranes, skids, jacks or other appliances that would usually be required for work of this nature. Although the method is not one that would ordinarily be applicable to heavy girders handled in general construction operations, the simple and effective use of the powerful apparatus at hand and some of the details of the operation are worthy items of engineering practice that are entitled to recognition and may afford valuable suggestions for other cases.



UNLOADING 90-TON BOX GIRDER FROM FLAT CARS AT CANAL

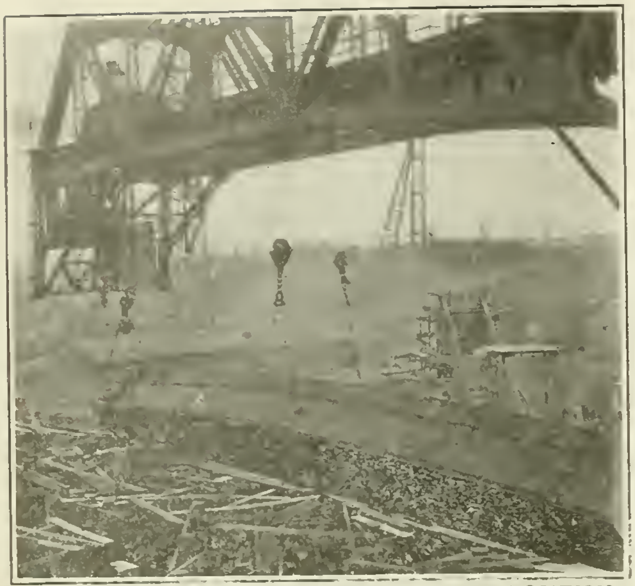
The Inner Harbor Navigation Canal of the port of New Orleans, for which Geo. W. Goethals & Co. were consulting engineers, has at each end lock gates that, in view of the history of other canals, may, it is assumed, sometime become crippled, making it necessary to provide for controlling the water in the canal under such conditions. This is accomplished by an emergency dam that is to be put in place when necessary a few feet above the gate where the canal is 75 feet wide and the maximum depth of water is nearly 50 feet, with a velocity of 10 or 15 miles per hour.

SECTIONAL STEEL DAM

One dam, which can be used at either end of the canal, is provided and consists of 6 heavy sections and 2 light sections, each section being a hollow box girder, 6½ feet high, vertically, and about 8 feet deep, horizontally, at the center point. One of the vertical faces is straight and the other is curved, and the heaviest girder weighs about 90 tons, exclusive of the ballast weight. All of the girders have a uniform length of 84¼ feet and are designed so that, if necessary, they can be floated from storage to the opposite end of the canal and yet so that their weight will be sufficient to sink them in the vertical wall guides to form successive horizontal courses of which the completed dam is composed. The girders, which were designed by Henry Goldmark, consulting engineer, of New York, were fabricated by the McClintic, Marshall Company, and shipped to the site, loaded on two flat cars each. At the site they were unloaded and placed in storage by a revoving steel crane of special design that has been installed on a fixed base to serve as a part of the permanent equipment of the canal.

UNLOADING WITH REVOLVING CRANE

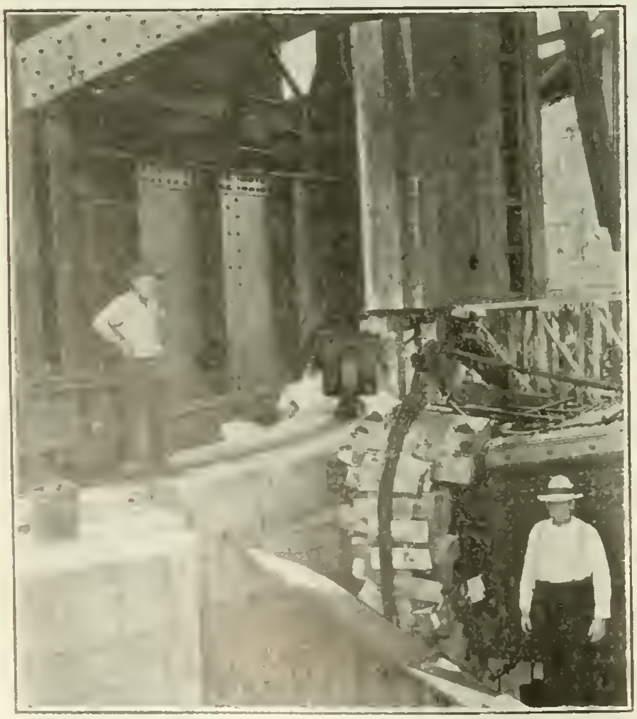
The crane has a trussed, double cantilever framework, somewhat similar to a swing bridge with one arm 104 feet long and the other arm 52 feet 5 inches long. It revolves through 360 degrees horizontally, enabling the long arm to reach across the full width of the canal, place the sections of the dam in position or remove them and put them in storage on skids with pile foundations in a semi-circular area prepared to receive them on the soft alluvial earth of the canal bank.



TURNING GIRDER 90 DEGREES TO FLAT POSITION, IN SLINGS

The crane is provided with powerful hoisting apparatus, mounted in the long and short arms, and the short arm is heavily counterweighted.

The girders were each delivered on flat cars with their vertical webs loaded in horizontal planes in order to secure necessary clearance. Short wooden blocks were packed around the webs and flanges of the girders and the ends to form cushions receiving several parts of steel wire rope that were seized together to form slings attached to the permanent overhead hoisting apparatus installed in the long arm of the revolving crane. Wire rope bridles were also attached to opposite sides of the girder at the center of gravity, connected to tackles suspended from the overhead revolving crane and operated by its hoists. The girder was lifted clear of the cars, with the convex face upward, swung to clear the masonry and then revolved 90 degrees, bringing the convex face vertical.



LASHING AND CUSHION BLOCKS AT EACH END OF GIRDER FOR LIFTING FROM CAR

REVOLVING GIRDERS IN SLINGS

The girder was lowered to a convenient temporary support on falsework, the lifting slings at the ends were released and removed, the cushion blocks removed and the multiple part slings replaced by new slings made with a single loop of heavy steel wire cable pulled through snatch blocks attached to the lifting device in the overhead revolving truss. The girder was hoisted clear of its support, and the end hoist locked in position, while the tackles attached to the ends of the center sling were operated, one being hauled up and the other slacked off, causing the girder to slowly revolve in the end slings, the latter remaining fixed relative to the girder.

After the girder had been placed on the temporary supports and the slings removed, it was picked up again by the large hooks, which form a part of the permanent lifting apparatus on the swing span, and the latter revolved, until the girder came directly over the recesses provided for it in the side walls. The girder was then lowered into place and will be kept in these recesses until the backfilling and the permanent storage supports on the top level are completed. The unloading, turning and lowering into place of the eight girders was done with a small crew, without serious difficulty and at very reasonable cost.

Daily Paper Good Roads Edition

The cause of Good Roads in Virginia is strongly supported by the Richmond daily "Times-Dispatch" and "Evening Dispatch," which, under date of August 18, issued a 44-page special number, edited by 28 prominent specialists and devoted entirely "to the cause of improved highways and setting forth the advantages and economic values that will accrue to the state when its present streaks of mud have given place to permanently surfaced roads."

The purpose of this edition is to inform the people of Virginia of the necessity of good roads in the development of the state commercially, industrially and socially, and to further the educational campaign to be conducted by the Virginia Good Roads Association during the fall.

This Good Roads Edition is a compendium of the highway situation in Virginia as it exists today, and is meant to serve as a permanent work of reference in the solution of the transportation problem toward which Virginia must bend its energies.

Last fall it was voted to amend the State Constitution so as to permit the legislature to authorize a $50,000,000 bond issue for the building of roads.

What Electrical Operated Valves Are Doing for the City of Buffalo

Since 1917 at least $12,000 worth of fuel per year, a large labor bill, about one-third of the per capita water consumption has been saved and expensive construction postponed by a vigorous campaign for improved conditions and operation, an important feature of which is the quick long-distance operation by electric control of valves on 36 and 48-inch mains that enable the high and low pressure systems to be rapidly connected to supplement each other or be independent

August 12, 1921.

Editor, PUBLIC WORKS:

Dear Sir: As per your recent request I am enclosing herewith tracing showing lay-out of discharge mains in the Col. Francis G. Ward pumping station and proposed electrical control on the 36 and 48-inch valves on the low pressure system with a brief description showing the reason for this control and results expected to be obtained.

Sincerely yours,
GEORGE C. ANDREWS.

In 1917 the Bureau of Water, City of Buffalo, started a campaign in an intelligent manner to reduce water waste consumption. This campaign was started with three objects in view:

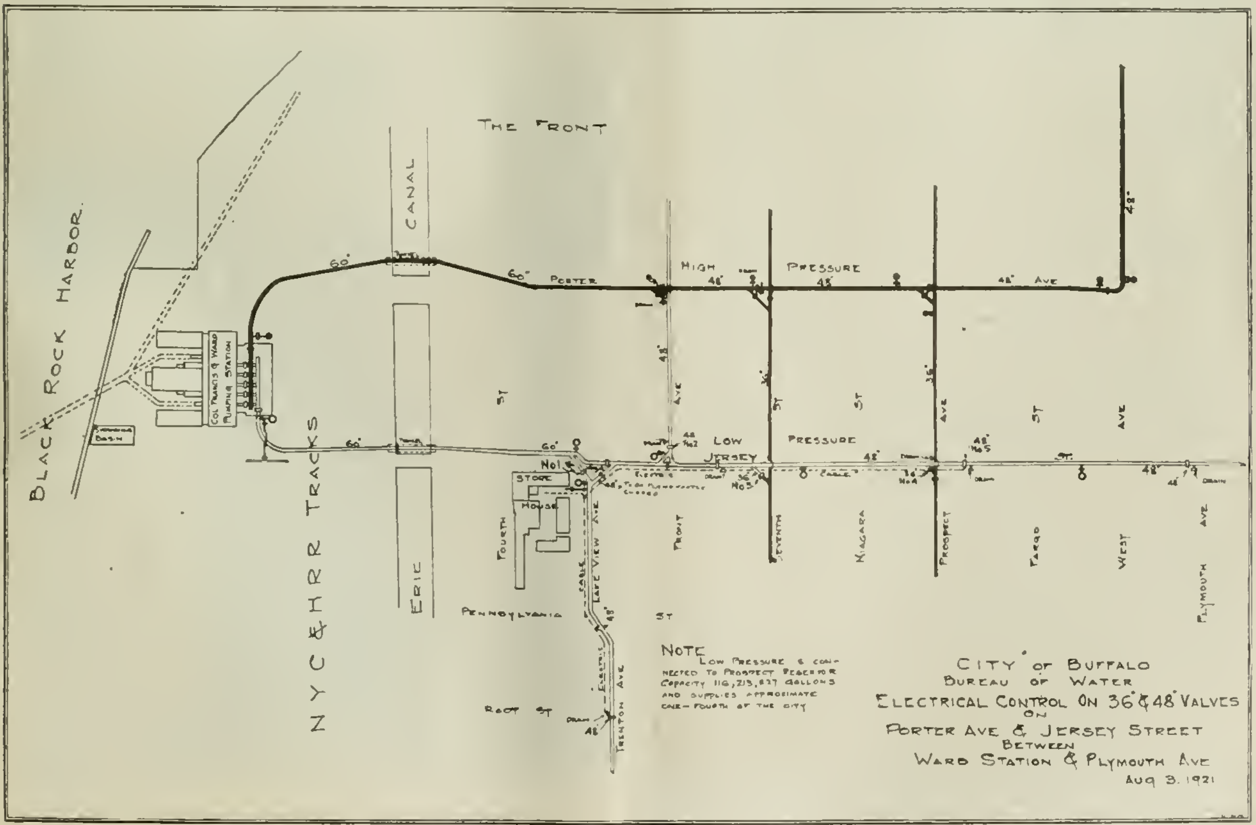
1st.—Reduction in operating cost due to decreased pumpage.

2nd—Eliminating necessity of laying new feeder mains on account of reduction in consumption.

3rd.—To reduce the total pumpage to a figure more in keeping with that of sister cities so that a filtration plant could be built at a much less expense than would be necessary if no control were exercised over the waste of water.

Since 1917 the per capita consumption has been reduced from 339 to 239 gallons and a continued reduction is being shown month by month. The average daily consumption for the past year was 120 million gallons with a daily peak load of 165 million and an hourly peak on the average day of approximately 150 million gallons.

Buffalo has two pumping stations—the Massachusetts avenue, equipped with six 30 million gallon triple expansion pumps, and the new Col. Francis G. Ward station at Porter avenue, equipped with five 30 million gallon pumps. The



NOTE
Low Pressure is connected to Prospect Reservoir Capacity 116,213,827 gallons and supplies approximately one-fourth of the city

CITY OF BUFFALO
BUREAU OF WATER
ELECTRICAL CONTROL ON 36" & 48" VALVES
ON
PORTER AVE & JERSEY STREET
BETWEEN
WARD STATION & PLYMOUTH AVE
AUG 3. 1921

DIAGRAM OF ARRANGEMENT OF DISCHARGE MAINS AND ELECTRICAL CONTROL VALVES FOR LOW PRESSURE WATER SUPPLY SYSTEM, BUFFALO.

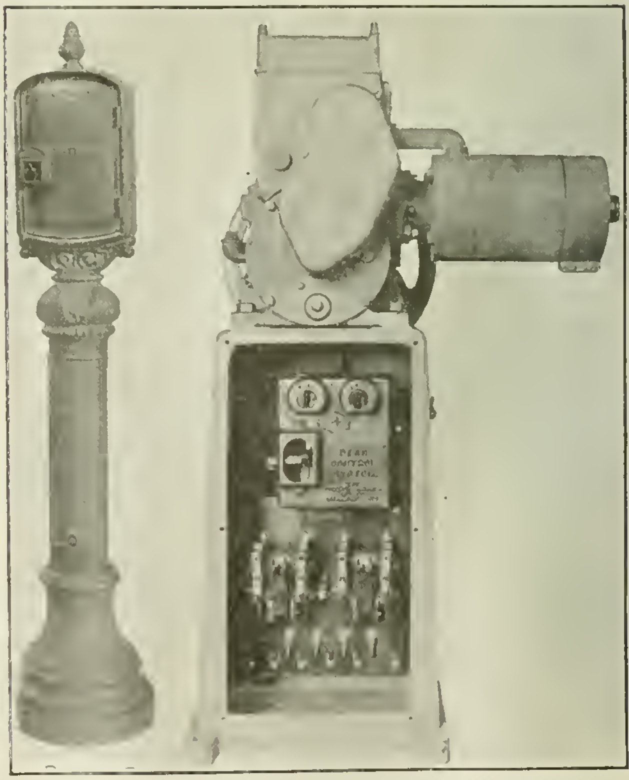
36-INCH RENSSELAER VALVE FITTED WITH DEAN CONTROL

more economical pumping can be done at the Ward station.

Water is supplied Buffalo at two pressures—the low, or reservoir service, and the high, or direct pumping service. The low service is connected with the Prospect reservoir with a capacity of 116 million gallons and supplies approximately one-fourth the daily consumption. The five pumps at the Ward station are connected by hydraulic valves with two 60-inch discharge mains—one on the low service, and the other on the high service. These discharge mains are connected with the 36-inch and 48-inch mains in Front avenue, Seventh street and Prospect avenue so that discharge from either main can be put on high or low service by operating the necessary valves. Under ordinary day's operation at the present time it is necessary to operate one of the pumps on the high service at the Massachusetts Avenue station in order not to overload the 60-inch discharge main on the high service at the Ward station. Besides that, we keep ample boiler reserve at the Massachusetts Avenue station to handle in emergency the entire high service pumpage, as the Ward station is dependent upon a single 60-inch main for its high service discharge and any failure in this line would leave three-fourths of the city without water.

By closing valves Nos. 1, 2 and 5 and opening valves Nos. 3 and 4 on the enclosed sketch, it is possible to put the 60-inch discharge main in Jersey street from low to high service and utilize it as an auxiliary high pressure discharge main. As the low pressure main is connected with a reservoir containing three days' supply for the section of the city on the low service and the area supplied is at sufficient distance from the pumping station so that the consumers cannot notice any difference in pressure whether they are fed from the pumps or reservoir, it is possible by opening and closing these valves to utilize the Jersey Street main for high pressure service during the hours of peak load and reducing the discharge materially through the 60-inch discharge main in Porter avenue. This will allow us to get the maximum output of 150 million gallons per day from the Ward station entirely on the high pressure system and will make it possible for us to meet all peak loan demands for 80 per cent of the year by the Ward station alone. During the night when the consumption is low the valves on Jersey street connecting with the reservoir will be opened, and those connecting with the high service closed, so that the reservoir can be filled. To operate these valves by hand would require not only the services of a large number of men but would consume considerable time and we have, therefore, contracted for the installation of electric control-valves at these points—same to be operated from the Bureau of Water Storehouse at the corner of Jersey street and Lakeview avenue. This scheme allows us to have duplicate discharge mains on the high pressure system from the Ward station and will allow us to bank our fires at the Massachusetts Avenue station and reduce the coal consumption at that point from 10 to 15 tons per day for approximately 300 days per year, resulting in a reduction in operating cost in fuel alone of $12,000 per year at the minimum, not taking into consideration the additional saving in labor.

In the original plan of the Ward station it was proposed, and building and tunnels were so constructed, that two additional 60-inch mains could be laid in the station, but the proposed system



STREET PILLAR BOX STAND FOR CONTROL STATION. DEAN VALVE CONTROL STAND WITH CONTROL SWITCHES IN WATERTIGHT COMPARTMENT of operating valves and utilizing both discharge mains on either high or low service makes it unnecessary to lay any additional 60-inch mains until such time as additional pumps are installed at the Ward station.

The contract for equipping these valves has been awarded to Payne Dean, Limited, of New York City, and work is being done under the direction of George C. Andrews, water commissioner. It is expected that contract will be completed by September 15.

The electrical control system is quite unique, inasmuch as there are two centralized points of control, one at the Lakeview Avenue storehouse, completely controlling five valves on Jersey street and the other control station at the Massachusetts Avenue gate keeper's house, controlling the ten valves in that section.

The problem of adapting a modern control system to old valves also had to be considered, as many of these valves bore no name and no identification mark as to number of turns required to operate.

The application of the Dean system is being made to each valve without in any way shutting down the supply, and during the time of construction the valves may be operated by hand in case of emergency.

The location in which the electrical operating device has to work is anything but desirable, since many of the vaults containing the valves are filled, or partially filled with water, and further, the Dean control units have to withstand rubbish and water that escape into the vault through the manhole covers. For this reason special attention is given to the design of the units to make them positively waterproof.

On Jersey street the valves will be operated from a pillar in the street, and adjacent to the valve, and also from the Lakeview storehouse, each valve then being operated from two points of control. The Massachusetts avenue valves are all operated from one point.

The cable conveying the current from the switchboard to the valves is all of the highly insulated lead covered steel taped type, buried about 24 inches below the ground level, and provided with waterproof joints wherever it is connected into the controlling apparatus.

The control units are to operate on current provided by the new turbine units being installed at the Francis G. Ward station. When this system is in operation it will enable each valve to be closed within ten minutes by merely touching a lever, providing at the same time indication by means of lights showing whether the valves are open or closed, and on one valve that is used for throttling purposes, an improved Dean position indicator is being installed, showing exact position of gate during its full length of travel.

The installation is such that the whole series of valves may be operated within a minute or so of each other, and electrical closing is accomplished by one man in a few minutes, whereas hand operation would require the best part of a day. Also the system will be utilized in case of leak or breaks.

Standard Test Specimens from Concrete Structures

Proposed tentative method for securing specimens of hardened concrete from the structure.*

The methods and precautions herein specified apply to securing test specimens from hardened concrete in the structure.

A specimen from hardened concrete to be tested for strength shall not be taken until the concrete has become hard enough so that the cutting of the specimen will not disturb the bond between the mortar content and the coarse aggregate of the specimen.

The specimen from the structure can best be secured by use of a core drill. For specimens taken perpendicular to a horizontal surface, a drill using chilled shot may be used; but when taken perpendicular to a vertical surface, a diamond drill should be used.

The core specimen taken shall be as nearly as possible a cylinder whose length is twice the diameter.

In securing a specimen perpendicular to a horizontal surface care shall be taken to secure, if possible, a specimen whose beds shall be parallel to the horizontal bed of the concrete as originally placed.

In securing a specimen perpendicular to a vertical surface, or to a surface with a batter, care shall be taken as to the point of securing the specimen. The lower portion of any one unit of depositing in mass concrete is more dense than is the upper portion of the unit, therefore a specimen shall be taken from near the middle of such unit of deposit.

A specimen to be taken from hardened concrete which has been removed from a structure shall be cut out by a drill or shall be cut into a symmetrical test-piece by tooling or by sawing. The method of sawing can seldom be used to advantage in the field. In selecting this test specimen care shall be used to see that the concrete selected has not been injured or shattered by the method of its removal from the structure.

The specimens secured shall have ends, or beds, as nearly as possible perpendicular to its axis, and, if the specimen has ends with uneven surfaces, these ends shall be made to parallel plane surfaces with a mortar richer than the mortar of the specimen or with a mixture of cement and calcined gypsum (plaster of Paris).

The state highway commission in New Mexico has launched a big road building program with six new Federal Aid projects, one to cost $46,707.02, a second to cost $65,505.67, a third $58,362.87, the fourth $41,624.73, a fifth $69,844.49, and the sixth $74,194.47.

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*Regulations proposed by the Committee on Concrete and Concrete Aggregates of the American Society for Testing Materials, and submitted by them for criticisms which should be addresses, preferably before January 1, 1922, to Mr. A. T. Goldbeck, Secretary of Committee C-9 on Concrete and Concrete Aggregates, U. S. Bureau of Public Roads, Washington, D. C.

NEWS OF THE SOCIETIES

Sept. 6-10—INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Colorado Springs, Colo. Secretary, C. R. George, Houston, Texas.

Sept. 7-9—LEAGUE OF VIRGINIA MUNICIPALITIES. Annual convention. Secretary, L. C. Brinston, Portsmouth, Va.

Sept. 12-17—NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES. Seventh exposition. Eighth Coast Artillery Armory, New York City.

Sept. 12-17—NATIONAL ASSOCIATION OF SANITARY ENGINEERS. Evansville. Ind.

Sept. 12-26 — AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS. Wilkes-barre, Pa.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 14-15—ASSOCIATED BUILDING CONTRACTORS OF ILLINOIS. Semi-annual meeting. Danville, Ill.

Sept. 19-21—ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA. Chicago, Ill. Secretary, P. J. McAndrews, C. & N. W. Ry., Sterling, Ill.

Sept. 19-23—INTERNATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONER. Chicago. Secretary, Ethelbert Stewart, U. S. Bureau of Labor Statistics, Washington, D. C.

September 19-24 — ASSOCIATION OF IRON AND STEEL ENGINEERS. La Salle Hotel, Chicago, Ill.

Sept. 22-24—NATIONAL DRAINAGE CONGRESS. St. Paul, Minn.

Nov. 14-16—CITY MANAGERS ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg. W. Va.

Sept. 23—AMERICAN SOCIETY OF MECHANICAL ENGINEERS, METROPOLITAN SECTION. Enginering Societies Building, New York City.

Sept. 26-30—ILLUMINATING ENGINEERING SOCIETY. Rochester, N. Y, Illuminating Engineering Society, Chicago Section, Chicago with National.

Sept. 26-30—NATIONAL SAFETY COUNCIL. Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventth annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 5-7—SOCIETY OF INDUSTRIAL ENGINEERS. National convention. Springfield, Mass.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta. Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building. Denver, Colo.

Oct. 12-14—LEAGUE OF KANSAS MUNICIPALITIES. Annual convention. Lawrence, Kans. Secretary, John G. Stutz. University of Kansas.

Oct. 20-21—OHIO STATE CONFERENCE ON CITY PLANNING. Annual conference. Columbus, Ohio. Secretary-treasurer — Charlotte Rumbold, Chamber of Commerce Building. Cleveland.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore. Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F, Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

Nov. 16-18—NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

NEW ENGLAND WATER WORKS ASSOCIATION

The 40th annual convention of the New England Water Works Association, founded in 1882, will be held September 13, 14, 15, 16, 1921, in Bridgeport, Conn. Headquarters: The Stratfield Hotel (Colonnade); meeting room, South Sun Parlor; exhibits, ball room.

TUESDAY, SEPTEMBER 13

2 p. m., introduction of Mayor Wilson: by S. P. Senior, chairman of local committee.

Address of Welcome: Hon. Clifford B. Wilson, mayor of Bridgeport.

Response by the president of the association.

Business meeting, award of Dexter Brackett medal.

A description of the water works of the Bridgeport Hydraulic Co. by S. P. Senior, president.

EVENING

Informal reception, with dancing, in Sun Parlor, Stratfield Hotel—8 p. m. until midnight. Courtesy of Water Works Manufacturers' Association.

WEDNESDAY, SEPTEMBER 14

Executive committee meeting at 8:30 a. m.

Morning session, 9 a. m.

Standard specifications for water meters. Report of Committee, Wm. W. Brush, chairman.

Manganese bronze for valve stems, by Wm. R. Conard, inspecting engineer, Burlington, N. J.

Monel metal, and its suitability for water works uses, by H. S. Arnold, of International Nickel Co., New York.

At the close of the morning session automobiles will be taken to the works of the Crane Co. for a trip through its plant.

Following this, opportunity will be given for a visit to the Bridgeport Sewage Treatment Works, where a Reinsch-Wurl screen is installed. These works are not yet in operation.

AFTERNOON SESSION, 2 P. M.

Superintendents' session.

The economy of high initial cost and extreme care in service pipe installation, by Reeves J. Newsom, commissioner of water works, Lynn, Mass.

The disappearance of the coating from cast iron pipe while stored in the yard, by Samuel E. Killam, superintendent of Metropolitan Water Works, Boston, Mass.

The control of water waste by house to house inspection, by Gordon Z. Smith, chief inspector, Bridgeport Hydraulic Co.

(This company installs meters only on **industrial and commercial services,** and depends **entirely on inspection to** prevent excessive waste by domestic consumers. Would it be wiser, more ecomonical or more equitable to use meters instead?)

Entertainment for the ladies (afternoon and evening).

Ladies' card party and music at Brooklawn Country Club, with special entertainment in the evening. Transportation will be provided. Prizes will be awarded to the winners at the card party. (Courtesy of Water Works Manufacturers' Association and Bridgeport Hydraulic Co.)

(Papers obtained by Water Works Manufacturers' Association.)

Reinforced concrete pipe as applied to water supply lines, by W. G. Chace, of the Lock Joint Pipe Co.

The selection of pipe for water works, by J. W. Ledoux, consulting engineer, Philadelphia, Pa.

The chlorination of New England Water Supplies, by Wm. J. Orchard, of Wallace & Tiernan Co.

THURSDAY, SEPTEMBER 15

Morning session, 9 a. m.

The electrolytic Generation of Chlorine at its point of application, by C. W. Marsh, consulting engineer, New York City.

The typhoid fever epidemic at Salem, Ohio, by W. H. Dittoe, chief engineer, Ohio State Board of Health.

The significance of "Hydrogen-Ion Concentration," in water purification, by Harrison P. Eddy, consulting engineer, Boston, Mass.

AFTERNOON SESSION, 2 P. M.

Can high-value water shed lands be put to profitable use? by S. P. Senior, president, Bridgeport Hydraulic Co.

The economics of the several lines of defense in the protection of water supplies, by Allen Hazen, consulting engineer, New York City.

Entertainment for the ladies. Guides will be provided and automobiles supplied for visits to points of local interest, and for rides into the country or along the Sound. Small parties will be made up for such trips.

EVENING SESSION, 8 P. M.

Water works accounting, discussion of committee report presented at 1920 convention.

An appraisal of the quality of water supplies in Massachusetts, by George C. Whipple, professor of sanitary engineering, Harvard University.

FRIDAY, SEPTEMBER 16

Morning session, 9 a. m.

The pollution of streams effecting industrial uses, by J. Frederick Jackson, director, Division of Sanitary Engineering.

The repairs to the standpipe at Bath, Maine, by Clarence E. Carter, assistant engineer, Metcalf & Eddy, Boston, Mass., and Walter F. Abbott, superintendent Bath Water District.

(The upper third of this standpipe was collapsed by wind pressure, and it remained in this condition for more than a year, after which it was repaired.)

Picnic and shore dinner, at "The Farms," (formerly the Black Rock Country Club). Facilities are provided for baseball, tennis, bowling, billiards, dancing, etc. (Courtesy of the Water Works Manufacturers' Association.)

Visits to works of Bridgeport Hydraulic Co. Small parties will be made up for excursions over the works of the company between sessions or at the convenience of the members.

Others visits or excursions—automobiles will be available at all times for the accommodation of members and their guests, to visit points of interest or for pleasure drives.

Golf—The links of the Brooklawn Country Club will be open to our members and guests, and arrangements will be made through the golf committee for tournaments or for individual play. All members who play at all are urged to bring their clubs. (Courtesy of Bridgeport Hydraulic Co.)

It is hoped that twenty or more players will signify their intention of participating, making it possible to run a two-day tournament, with fligts of eight players starting the qualifying round Wednesday morning and continuing that afternoos and all Thursday. If there are too few for this touranment, ball sweepstakes will be played. Prizes have been provided by the Water Works Manufacturers' Association. Notification of intention to play should be sent at once to the chairman of the Golf Committee, Egbert D. Case, Pitometer Co., 50 Church street, New York City.

INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS

The second annual conference of the International Association of Street Cleaning Officials was held in Chicago August 10 and 11. The main topics discussed at this meeting were methods of street cleaning and the disposal of refuse. The program included no papers, but was arranged to cover six subjects for discussion, which took the form mainly of recitations of experiences of the official speaking.

Three amendments were made to the constitution. These were that the name of the association be changed to the International Association of Street Sanitation Officials; that three vice-presidents instead of one be included in the list of members; and that associate membership be extended to engineers and publishers.

The following officers were elected for the ensuing year: President, W. J. Galligan; vice-presidents, Abram Swan, E. F. Murphy and J. S. Miller; secretary, A. M. Anderson; and treasurer, R. W. Waddell.

KANSAS CITY ENGINEERS CLUB

By a letter ballot recently taken the Kansas City Engineers' Club has decided to discontinue its affiliations with the American Association of Engineers. As this leaves the American Association of Engineers unrepresented in that city, steps have already been taken for the establishment of a chapter of the A. A. E. in Kansas City.

WESTERN SOCIETY OF ENGINEERS

The following officers have been elected by the Western Society of Engineers for the ensuing year: President, Charles H. MacDowell; vice-presidents, Julius L. Hecht, F. F. Fowle and B. S. Shapiro; and treasurer, Homer E. Niess.

PERSONALS

Lehman, George M., has been appointed chief of the newly formed division of waterways of the bureau of statistics and information, Department of Internal Affairs, Pennsylvania.

Gordon, J. Blake, senior assistant engineer of the sewer department, District of Columbia, has been appointed sanitary engineer to succeed Asa E. Phillips, who resigned.

McClendon, W. W., has been appointed consulting engineer for Navarro county, Texas.

Mahlie, W. S., of Columbus, Ohio, has been appointed bacteriologist in charge of the filtration plant for the Fort Worth, Texas, water works.

Clark, F. M., formerly assistant chief engineer of the Nova Scotia Highways Board, has been appointed construction engineer for the Maine Highway Commission.

Eichelberger, Fred O., director of public service of Dayton, Ohio, for more than a year past, has been appointed city manager in place of W. C. Barber, resigned.

Skeggs, Major John H., has been appointed acting division engineer of Division four by the California state highway commission, to take the place of W. Lewis Clark.

Maier, Edward H., has been named city engineer of Bridgeton, N. J.

Painter, P. C., formerly city engineer of Washington, N. C., has been elected city manager of Greensboro, N. C.

May, Charles A., has been appointed state engineer of New Mexico.

Phillips, Asa E., has resigned as sanitary engineer of the District of Columbia, after more than thirty years' continuous service with that district.

Smith, Herman H., formerly chief engineer of the bureau of highways, borough of Brooklyn, N. Y., has been appointed chief engineer of the New York Board of Estimate and Apportionment.

Miller, Frederick R., has been appointed member of the Ontario Hydroelectric Power Commission.

Ferver, A. L., has been appointed director of public service and ex-officio city engineer of Long Beach, Cal.

Cochrane, John L., for many years statistician of the United States Bureau of Mines, died in Cleveland recently.

Rondeau, C. W. H., of Westmont, Que., has been elected president of the Union of Canadian Municipalities.

Waddell, Charles E., of Asheville, N. C., has been appointed chairman of the North Carolina state board of registration for engineers and surveyors which was created by the last legislature.

Coleman, H. W., former superintendent of the water and sewer departments of Greenville, Miss., has been appointed city engineer and superintendent of streets, Albany, Ga.

Cooper, C. M., has been appointed county engineer of Crawford county, Kan

Fletcher, A. B., who has been appointed director of the department of public works of the state of California under the reorganization plan has announced the following appointments in his department: Chief of division of land settlement, Dr. Elwood Meade; chief of division of engineering and irrigation, Wilbur F. McClure; chief of division of architecture, George B. McDougall; chief of division of water rights, C. H. Lee.

Smith, Prof. Leonard S., has been engaged to act as advisor to the Appelton, Wis., city planning commission.

Tour, Dr. Reuben S., has been appointed professor of chemical engineering and commerce, University of Cincinnati.

Cravens, C. L., has accepted a position with the Florida State Road Department.

Pierce, Rolland, is now in charge of the distribution of water for irrigation from Portneuf river at Boise, Idaho.

Vincent, A. W., has been appointed city engineer of Albany, Ga.

Coleman, Col. H. W., has been appointed city engineer of Albany, Ga.

Hickok, Maj. Clifton E., has been made city manager of Alameda, Cal.

The new bipartisan water board of Kansas City, Mo., is composed of Alexander Maitland, construction engineer and president of the Kansas City Bridge Co., chairman; George H. Edwards, president of the Edwards, Ludwig, Fuller Jewelry Co. and former mayor of Kansas City; Hughes Bryant, real estate broker, building advisor and fiscal agent; and Louis P. Rothschild, president of Rothschild & Sons, clothiers.

INDUSTRIAL NOTES

Finch, Jeremiah C., has been appointed secretary of the New York State Highway Commission.

Grant, J. A., is designing the hydraulic work on the reconstruction of works in Pueblo, Colo.

Morgan, Arthur E., has resigned as chief engineer of the Miami Conservancy District and will divide his time between engineering practice with the Dayton Morgan Engineering Co., Dayton, Ohio, and his work as president of the Antioch College at Yellow Springs, Ohio.

Paul, Charles H., will succeed Arthur E. Morgan as chief engineer of the Miami Conservancy District.

Van Dusen, E. A., has accepted a position with the Power Construction Co., Worcester, Mass.

Bean, Benjamin, has been appointed field engineer with the State of Missouri on Project 99, Clay county, on federal aid highway construction.

Martin, Cedric A., has been made construction engineer for the city of Payallup, Wash., on sewer and paving work.

Smith, Jr., Martin W., is now assistant city engineer of Clarksburg, Va.

Leland, O. Miner, is now the dean of the engineering department of the University of Minnesota.

Monsarrat, Charles N., has been appointed consulting engineer of bridges, Canadian National Rys. He will continue his private practise.

Greene, Prof. Arthur M., will take up his new duties as dean of the engineering school and professor of mechanical engineering at the Rensselaer Polytechnic Institute in September, 1922.

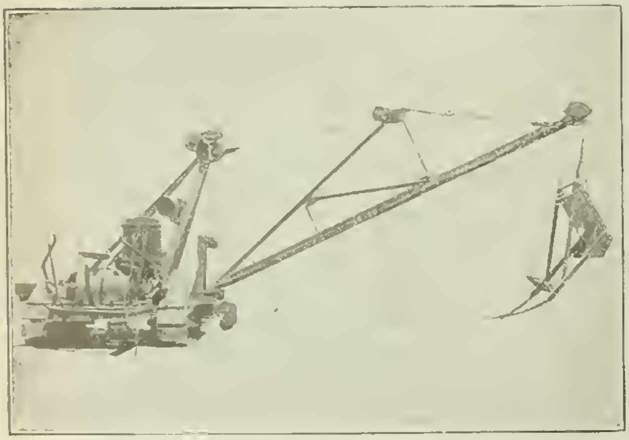
New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

NEW 18 H. P. BACKFILLER

P & H 203 is the new power backfiller designed by the Pawling & Harnischfeger Co., of Milwaukee, to speed up the work of backfilling trenches and ditches. This machine is mounted on full corduroy tread and is operated entirely by one man, who guides the progress of the machine as well as the scraper bucket and boom. The boom on the 203 is 30-foot maximum, 20-foot minimum, and the engine is a heavy duty 18 h. p., four-cylinder gasoline unit. pipe trench.

With the boom extended to its maximum length of 30 feet, four loads may be filled in one minute. With shorter boom length more loads are handled. With this P & H backfiller the operator can work steadily without fatigue and do the same work as a crew of 40 to 50 laborers backfilling with shovels. The construction is like P & H excavator-cranes; the body being made of heavy I-beams; gears cut from solid block; steel plate corduroy treads, gear-driven; and centralized control.



BACKFILLER MOUNTED ON CORDUROY TREAD

DITCHING WITH A MARTIN PERFECT ROAD MAKER

The Martin perfect road maker machine, manufactured by the Owensboro Ditcher & Grader Co., is a V-shaped scraper plow with a 5 to 7-foot blade and a long steel-plated wooden extension arm to throw the loose earth farther away. It is provided with a swivel joint, enabling the machine to be quickly reversed and can be hauled by horses or by a tractor.

It can be operated by one man and is satisfactory for digging ditches in rough and hilly ground. It is also serviceable for cleaning out ditches. In Logan county, Ky., 28 of these machines are in use on the roads, in McLean county 25, in Marshall county 16, in McCracken county 15 and in Marion, Ala., 18, besides numerous other counties in the southern states that use from 2 to a dozen each of the machines.

CUTTING A DITCH WITH THE MARTIN PERFECT ROAD MAKER

INDUSTRIAL NOTES

The International Diamond Drill Contracting Co. has been awarded the contract for making diamond drill explorations at the site of the Columbia river dam near the Grand Coulee, Wash., in order to determine if granite bedrock lies within 100 feet below the glacial deposits.

The contract was awarded on the basis of the payment of costs and a fee of $19 per day of two eight-hour shifts with the option of continuing the work after one month on a basis of cost plus $1 to $1.50 per foot drilled.

The Williamsport Wire Rope Co. has doubled the capacity of its Chicago warehouses, facilities being afforded for immediate shipments of any size and construction of wire rope.

TRAFFIC TRUCK

The Traffic truck manufactured by the Traffic Motor Truck Corporation has a capacity of 4,000 pounds or 1.7 yards of sand, gravel or crushed stone, and is provided with flare boards 10 inches high. The all-steel dump body has an especially designed rear end gate hinged at top and locked at bottom, that is operated by a lever at the driver's seat and may be revolved 270 degrees to lie flat on top of the body, thus permitting lumber and other long materials to project beneath it.

The truck is furnished with a hand hoist used to lift the capacity load with a force of only 25 pounds pressure on the handle. The side rails form a positive stop for the dump body in its highest position and thus prevent it from being carried over by the rush of material out of the rear end gate.

STANDARD STEEL WORKS MOVES

The Standard Steel Works, 1722 Tracy avenue, Kansas City, Mo., have just completed a new plant at 16th and Holmes streets, North Kansas City, Mo., and are moving into it this month.

The new plant is a modern daylight factory building of steel and brick construction. The factory, all on one floor, with office occupying second floor. The building has 30,000 square feet of floor space.

This modern plant is devoted to the manufacture of standard steel dump bodies, hand hoists, truck tanks, road workers' equipment, and a complete line of mill and elevator equipment. Their business has been increasing rapidly during the last year and they will have a much larger capacity in their new location.

The Merchants' Steel & Supply Co., Chicago, has become sole distributor for the products of the Tubal Chemical Co., producers of specialties for the iron industries.

J. A. Henry has been appointed Western district manager of the Warren Iron & Steel Co., Warren, Ohio, with offices at 1810 Continental and Commercial Bank building, Chicago.

F. Stugard, formerly superintendent of the Kosmos Portland Cement Co., Kosmosdale, Ky., has resigned, and E. J. Davis has been engaged as superintendent of the plant of this company.

B. J. Latimer has been appointed superintendent of the Nebraska Cement Co., Superior, N. Y.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 SEPTEMBER 10, 1921 No. 11

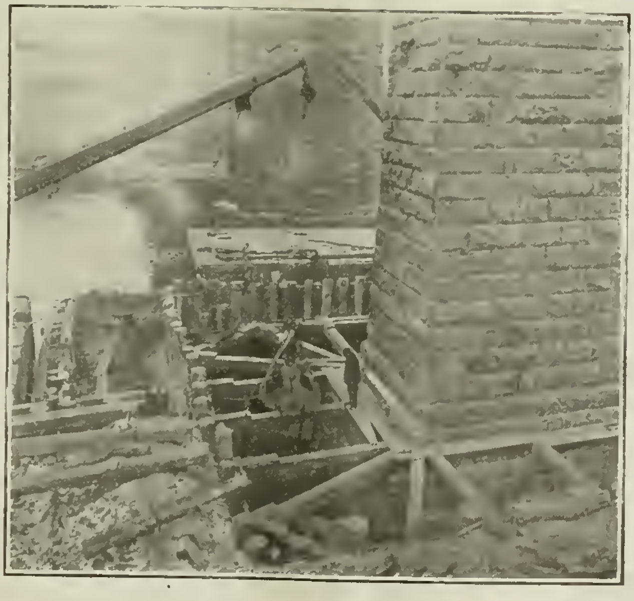
Crib and Cofferdam Work*

General Conditions, requirements and types. Bag, earth and sheet pile cofferdams. Cofferdams for battleship Maine, for 46th street pier, and Thames bridge.

Cofferdams are engineering structures, generally temporary, that are built to exclude river, lake, or sea water or ground water from an enclosed space and facilitate operations after construction therein. They are usually supplementary to the building of foundations such as those for bridge piers, abutments, sea walls, canal locks, buildings and other purposes, but may be used in any kind of engineering construction. They are usually designed to resist an unbalanced hydrostatic pressure and to permit the water to be pumped out on the inside.

A large proportion of them are built of type and material that are considered most convenient under the circumstances, and are thus frequently without proper design so that they are often unsatisfactory and sometimes unsafe and very expensive and their construction is generally dreaded by ordinary contractors or engineers without experience in their use. This is largely due to the fact that the conditions to be met are often concealed and seldom properly investigated before the cofferdams are built unless the latter are known to be of extreme difficulty or importance.

When the water is very deep or very swift, or if the bottom is very bad, the design, construction and maintenance present many difficulties and are expensive, but even under these circumstances cofferdams can generally be successfully installed and maintained if properly designed and built but may involve large costs or other difficulties. In all cases their design and construction should be preceded by a very thorough investigation and by an exploration of the site that will dispose of all necessary information concerning the foundation.



UNDERPINNING PIER OF CENTRAL VIADUCT, CLEVELAND, IN COFFERDAM WITH PUDDLE CORE BETWEEN WOODEN EXTERIOR AND STEEL INTERIOR SHEET PILES

TYPES

Cofferdams are either fixed or moveable and are built on a natural or excavated earth or rock surface or on some artificial structure.

The principal types of cofferdams are—embankments, sheet piles, sheet pile and embankments, sheet pile and fill, cellular sheet piles, framed cofferdams, detachable cofferdams, crib cofferdams and caisson cofferdams. Although cofferdams frequently consists of one, two or three sides connecting existing sides of walls they will here be considered as complete enclosures, either circular or polygonal and unless otherwise stated, as seated on or penetrating the surface of the earth or rock on land or in the river bed or at the bottom of any body of water. They will also be considered in general as having their tops a short distance above maximum water level, designed to permit the water to be entirely pumped out from their interior, leaving an unbalanced water pressure or earth pressure on the exterior.

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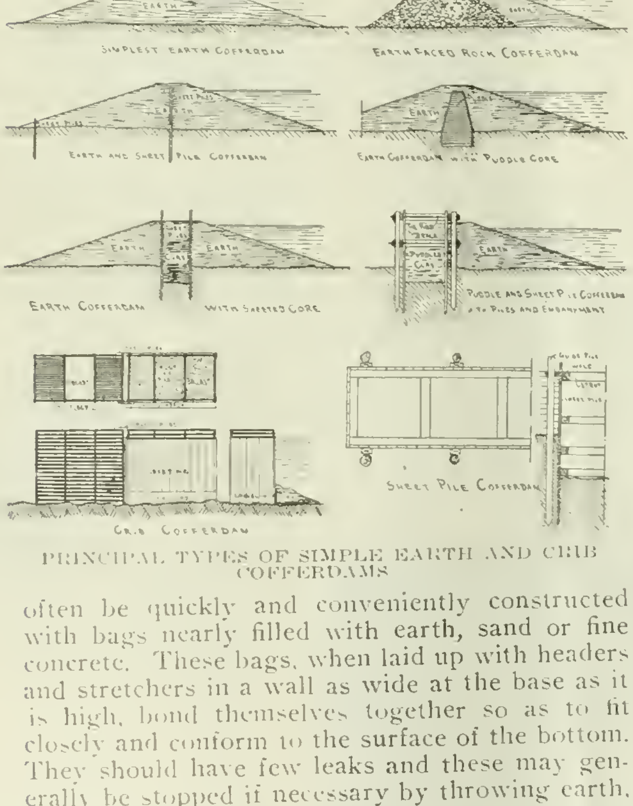
*Abstract of stereopticon lecture delivered May 23, 1921, to the senior class in the College of Civil Engineering, Cornell University, by Frank W. Skinner, consulting engineer, associate editor PUBLIC WORKS.

Cofferdams must be designed to resist lateral displacement or overturning by the exterior horizontal pressure, to resist any erosion and impact to which they may be subjected, and to be reasonably impervious to seepage, percolation or other leaks through the body of the cofferdam, and to have a practically watertight joint between the entire base and its supporting surface, not only to prevent leak there, but to prevent upward pressure of the water, which would greatly impair the stability of the cofferdam against overturning. Usually, however, cofferdams with gravity cross-sections are built without regard to the buoyancy of the materials and have sufficient weight for statical stability.

EARTH COFFERDAMS

On smooth, hard bottom of any description low cofferdams, not more than 2 or 3 feet high, may often be quickly and conveniently constructed with bags nearly filled with earth, sand or fine concrete. These bags, when laid up with headers and stretchers in a wall as wide at the base as it is high, bond themselves together so as to fit closely and conform to the surface of the bottom. They should have few leaks and these may generally be stopped if necessary by throwing earth, sand, and clay on the outer surface.



PRINCIPAL TYPES OF SIMPLE EARTH AND CRIB COFFERDAMS

Under suitable conditions efficient cofferdams may be cheaply and satisfactorily made with earth embankments. Ordinarily **both faces of these** embankments have the natural slope of the material and the thickness of the embankment at the top should be at least 5 or 6 feet and sometimes much more. The cofferdams, therefore, require a large amount of material and occupy a great deal of space, their slopes extending a long way from the center line on the inside of the cofferdam and thus necessitating very large horizontal dimensions on the center. Such cofferdams are generally built much as fills or embankments for railroad grades, the material being excavated at the site or brought in dump cars or scows and placed in position.

Sometimes all or part of the cofferdam material is derived from excavation made within the cofferdam, which builds up the embankment as it is carried down. Ordinarily this excavation would be made with a clam-shell, orange-peel or grab bucket or by a dipper dredge or sometimes even by a suction dredge, but there have been interesting examples of very cheap, rapid and efficient cofferdam construction where the cofferdam was built of material excavated from the inside of the cofferdam by a dragline bucket that excavated and deposited it in position at one operation.

Clayey sand and gravel are generally the best available materials for earth cofferdams, because they are usually abundant locally and easily form an almost impervious mass, but the cofferdam can be built of almost any convenient material from sand to gravel or broken stone to form the body if it is made with a sufficient thickness of impervious material covering the outer face or if it has a central core of such material or in fact any watertight wall or diaphragm to exclude the water provided the latter is protected and given stability by the adjacent embankment.

An earth cofferdam can be built on the most irregular surface to which it automatically adjusts itself, but its use is limited because it does not endure swift currents or wave action, tidal movements or heavy drift, and for obvious reasons it cannot often be built to great height unless the earth is provided from a nearby spoil bank or by the excavation necessarily required inside the cofferdam because otherwise the earth cannot be provided economically for so large a structure and some other type has to be designed.

If an earth cofferdam is to remain long in service it is often advisable to protect the outer slope with rip-rap or some other kind of pavement near the surface of the water. Sheet piles well driven on the center line of the cofferdam, so as to penetrate the hard stratum below the foundation and extend up into the body of the cofferdam where they are enclosed in the material for the embankment serve as core walls which are valuable elements of cofferdams on soft or quicksand bottoms and where the material of the dam itself is not sufficiently impervious. Similar results can be secured by digging or dredging a trench on the center line of the cofferdam and filling it with clay well rammed or puddled to form a wall that continues up into the embankment above. If properly made, such core walls will give very good results and resist leakage.

SIDEWALLS, SHEET PILES, CAISSONS AND LEAKS

Earth dams* with 3 on 1 slopes, built of a mixture of gravel and clay may be tight without core walls; if exposed to erosion or impact they should be protected. When built on permeable bottoms they should have some kind of integral cut-off extended down to impervious stratum if possible.

Cofferdams may be made with earth or clay filled in between parallel rows of wooden or steel sheet piles driven between double rangers and connected by horizontal through screw rods. Wooden sheet piles should have the lower ends beveled and precautions should be taken to drive them with tight installation joints.

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*Abstract of portion of lecture quoted from article on Cofferdams by the author published in PUBLIC WORKS, Oct. 23, 1920.

Sheet piles should be assembled all around the circumference of the cofferdam and each be driven a short distance at a time successively by a hammer going around and around the full length of the circumference of the cofferdam. Sheet piles are driven by hand as excavation progresses or by steam or air hammers with or without the aid of a water jet. They may be driven against complete interior bracing frames sunk in position beforehand. They may enclose boulders and other obstructions they cannot penetrate.

Cofferdams may have their walls made of wooden panels bearing against piles or framed skeletons, they may be complete boxes or caissons with or without batterns and with permanent or temporary, or fixed or detachable sides and may be made of wood or steel.

Leaks in cofferdam walls may be stopped by sheet piling around them, by divers' work or by filling in earth puddle, etc., outside them. When there is much upward leakage through the bottom of a cofferdam, it is often controlled by building a large cofferdam in successive sections or by subdividing it by temporary cross walls and concentrating the pumping on a much reduced area.

STEEL SHEET PILE COFFERDAMS

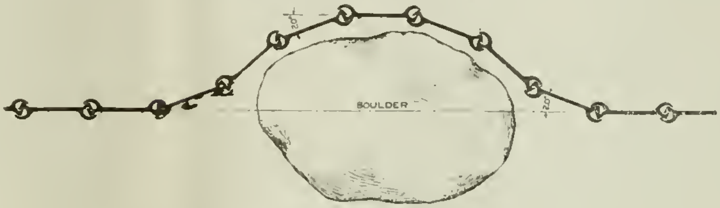
A large and increasing proportion of high cofferdams are made with interlocking steel sheet piles driven and often pulled with heavy hammers operated by steam or compressed air.

The assembling of long lengths of steel piles is often very much facilitated by attaching a guide piece to the top of the last pile assembled to promote entrance in the joint of the next pile. Steel piles can be secured in lengths as great as they can be shipped, but are ordinarily up to about 35 feet long and spliced if necessary with bolted web plate. Sometimes the lower section of the pile is allowed to remain permanently in the ground while the upper section is unbolted and removed, especially in subaqueous work.

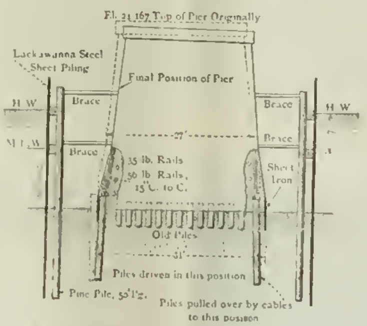
Steel sheet piles are often pulled and redriven, some used for a sewer trench in Salt Lake City being redriven 75 times. Piles are generally assembled by means of a derrick, but for sewer trenches and the like are more conveniently handled by a traveling gantry, or similar moveable contrivance specially arranged for handling tackle with which the piles are pulled. Piles are usually pulled with tackle, with levers, and very often, especially for long piles, by means of a double-acting steam hammer. The pulling of piles is sometimes facilitated by means of a water jet or by first driving the piles lightly to break the friction. When piles are to be pulled and redriven and sometimes when they are not and the driving is very hard, they must be driven with a cap to protect the upper end. Very thin and wide piles may be protected in driving by inside and outside temporary driving bars designed in connection with the spring lock piles. Piles may be pulled with simple bolts, and with powerful grips or tongs engaging the webs with frictional bearings.

CELLULAR COFFERDAMS

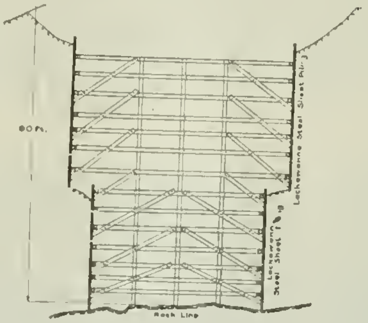
Piles 72 feet long driven through clay and gravel and embanked with earth and rip-rap for the 46th St. pier, New York, were pulled by a 3,000-pound hammer combined with a tackle that exerted 40 tons tension and submerged one end of the derrick boat to a depth of 3 feet. They were pulled at an average rate of 20 in 8 hours and a maximum rate of 38.



SHEET PILES (COFFERDAM) DETOURED TO ENCLOSE OBSTRUCTION



SHEET PILE COFFERDAM WITH INTERIOR PILES AND SHORT BRACES

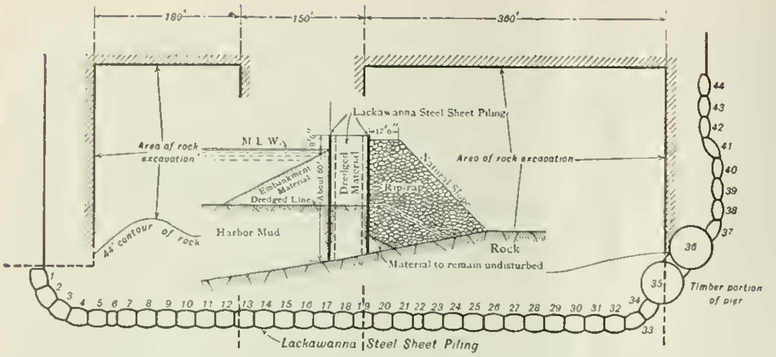


DEEP SHEET PILE COFFERDAM WITH HEAVY CROSS BRACING

The Blackrock U. S. shiplock cofferdam, Buffalo, is 245x970 ft. with walls 30 ft. thick and 45 to 50 ft. high composed of double rows of steel sheet piles 30 ft. apart connected by interlocked steel sheet pile partitions about 30 feet apart and filled with sand, clay or gravel to give it independent stability without bracing across the interior of the cofferdam. This construction required 6,780 linear feet of steel piling weighing 6,890 tons and 60,000 yards of clay fill and clay bank. The piles were driven through about 8 feet of water and 30 to 40 feet of sand and gravel to bed rock. They were 40 to 50 feet long and were driven with a 10,000-pound steam hammer. The cofferdam was watertight and it was finally removed by pulling the piles with 6-part tackles. The filling between the partitions being first excavated to a depth of 12 feet by a clam-shell dredge.

The cofferdam for the battleship Maine was about 400 feet long and 220 feet wide on center line, made with 20 tangent 50-foot cylindrical sheet pile cofferdams driven through 37 feet of water to a penetration of about 25 feet in the soft bottom, and filled with dredged material.

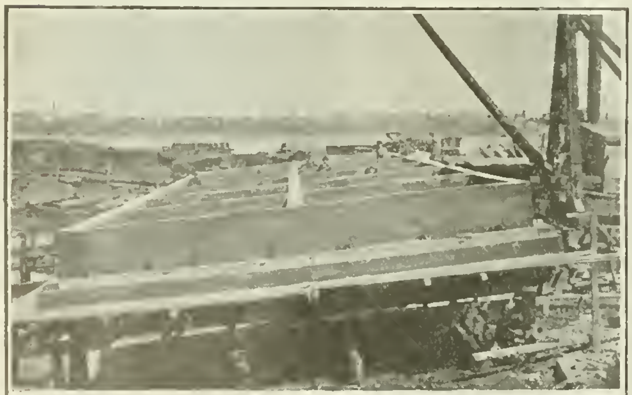
Three piers for the double-track Thames river



CELLULAR FILLED STEEL SHEET PILE COFFERDAM IN DEEP WATER WITHOUT BRACING

bridge at New London, Conn., were built with crib foundations carried to rock from 100 to 150 feet below the surface of the water 50 feet deep and through mud and sand. The 42 x 99-foot open cribs were sunk by interior dredging to depths of 90, 130 and 131 feet below low water level, each crib had vertical walls of 12 x 12-inch solid horizontal timbers covered with 12 x 3-inch sheeting and provided by interior partitions into 8 open dredging wells and 12 ballast pockets. The timber walls were seated on a reinforced concrete cutting edge 13 feet high containing 700 yards of concrete and weighing 1,500 tons. The cutting edge and about 7 feet of the lower part of the walls were built on a convenient ship railway, the bottoms of the dredging wells were temporarily closed by heavy planking and transverse trusses and the cribs were launched, completed while floating, and sunk to position by interior dredging. Sinking through the 80 feet of mud, clay and gravel was facilitated by the use of about 100 hydraulic jets under 165 pounds pressure that were finally replaced by a single 1¼-inch jet operated whenever and wherever necessary and a full pump pressure derived from a 150 h. p. boiler, sufficed to tear up the heavy clay bottom and undermine any of the pockets.

(To Be Continued)



CONCRETE CUTTING EDGE FOR TIMBER CRIB FOR THAMES RIVER BRIDGE.

LAUNCHING TIMBER CRIB WITH CONCRETE CUTTING EDGE AND TEMPORARY FALSE BOTTOM.

Powerful Floating Derrick

The new 100-ton floating derrick, designed by L. S. Rosener for the Crowley Launch and Tugboat Company, San Francisco, has a steel tripod 85 feet high mounted on a 50 x 125-foot scow, 11 feet deep, and equipped with a 100-foot steel boom. It has a capacity of 100 tons at 50-foot radius and 18 tons at maximum working radius. There are installed on the scow an oil burning Scotch marine boiler, steel tanks for 200 barrels of fuel oil, 400 barrels of fresh water, a hoisting engine, wrecking pumps, electric lighting plant and an air compressor with a capacity of 390 feet, to supply drills and other tools and to fill pontoons for floating wrecked hulls. Living accommodations for a large crew, fuel and water and other supplies are provided sufficient to enable the scow with the derrick to remain for several weeks on an outside job.

St. Lawrence River Canalization Opposed

In an address delivered to the Buffalo Chamber of Commerce, August 20, Nathan L. Miller, Governor of New York, opposed the canalization of the St. Lawrence river for ocean-going vessels at a cost estimated by some experts at $1,000,000,000 or more. He considered it impracticable and that it was promoted by agitators and impractical theorists and not by able, practical navigators.

He objected under present financial conditions to taking from the treasury of the state money to construct a waterway in a foreign country, especially when that money is needed to develop all of our own harbors from Boston to Galveston, and to improve our own waterways. Specifically he pointed out that the Mississippi can be capable of tapping a large section of the grain belt and it might then be more economical to ship some of the grain from that belt to the Gulf, and he does not propose to permit the St. Lawrence water power rights to be turned over to private interests.

Hydro-Electric Power in France

It is reported that the French Government has prepared plans and is expecting to carry out construction of hydro-electric power plants along the River Rhone, which will have a capacity of 800,000 h. p. and cost twenty-five hundred million francs, or say about $300,000,000. In addition to creating the power named, it is said that it will also make possible the reclaiming by irrigation 500,000 acres of waste land around the mouths of the Rhone. The carrying out of the entire plan will probably take 15 or 20 years, but the first feature, consisting of a great dam at Genisseat and a smaller one at Bellegarde may be completed within 10 years, the dam to be about 200 miles from Paris and current to be brought that distance for lighting and other use in the capitol. In addition to creating power and irrigation, this development would make the Rhone navigable for a distance of about 300 miles above Marseilles.

A Small Derrick Operated by Two Hoists

A home-made derrick, operated by compressed air was recently used for clearing away the debris of a burned 600-ton mill of the Silver Queen Coalition Mines Co., at Park City, Utah, about 35 miles south of Salt Lake City.

The derrick mast and boom were made with telegraph poles and were rigged with simple tackles made with single-sheave blocks. The lead lines passed around sheaves mortised in the boom and mast, and were operated by separate Little Tugger hoists bolted to the lower part of the mast.

This derrick had a capacity of about 3 tons and handled 90 per cent of the wreckage from the fire. The boom was swung by hand.

The hoists, operated by compressed air, are very light, compact units consisting essentially of a drum, driven by a small rotary engine enclosed in an attached housing. They are very simple in construction and operation and are so light that they are portable and convenient to attach to almost any available support and can be used for a great variety of purposes in hoisting, hauling and the like, wherever there is a convenient supply of compressed air and especially where the service is light and where space is limited as in tunnels.

California Hydro-Electric Power

Since last summer, when a power shortage developed in California, 300,000 horsepower has been developed by new hydro-electric plants and plants with a capacity of 250,000 horsepower are under construction. The power companies of the state prepared plans for developing a million and a half horsepower by 1930, the power available a year ago having been about one million horsepower.

One of the recently completed plants, the Caribou plant of the Great Western Power Company, is said to have broken the world's record by transmitting current at 165,000 volts over aluminum cables nearly one inch in diameter for a distance of 186 miles to the San Francisco Bay district.

Most of the increase is hydro-electric power, but one plant uses natural gas for power and another burns coal.

Detroit Water Mains

Installation, maintenance and cost of water mains in the 1,368-mile system that in the year ending June 30, 1920, supplied a daily average of 151,997,985 gallons.*

The city of Detroit with a population of 993,739 and an area of 79.7 square miles, has a water distribution system of 1,368 miles of all kinds of pipe from 2-inch to 48 inches in diameter, supplying the high, low and intermediate pressure districts, into which the city is divided.

The total pumpage for the year was 55,631,262,500 gallons at a cost of $389,164.96, including $156,825.83 for labor and $209,672.27 for fuel. Figured on the total maintenance plus the interest on bonds, the cost of supplying water was $15.02 per million gallons. During the year 109 miles of new water mains were completed and the total cost of work on the mains completed and in progress during the year was $3,121,950.14.

AMOUNT AND COST OF NEW MAINS

The principal sizes of pipe laid included 273,684 lineal feet of pipe 6 inches in diameter, 243,050 feet of 8-inch, 24,957 feet of 12-inch, 8,312 feet of 16-inch, 9,573 feet of 24-inch, smaller quantities of 10, 30, 36, 42 and 48-inch, the total amount of pipe from 24 to 48 inches in diameter, inclusive, aggregating 7 miles. Two large additional storage yards have been acquired and the city maintains a large supply of pipe for repairs, extensions and replacements, from which there were issued in the last year 58,325 pieces of pipe in sizes from 6 inches to 48 inches, weighing 26,661 tons; 4,239 fittings, weighing 504 tons; 1,487 gate valves from 2 inches to 48 inches in diameter, and 238 tapping valves, 2 inches to 12 inches in diameter.

On March 9, 1920, a contract was entered into with Julius Porath, contractor, for furnishing and laying 20,930 lineal feet of 48-inch lock-bar steel pipe at a price of $31.94 per foot. This pipe is made from sheets one-half inch in thickness, is dipped in "hermastic" coating and will continue as far west as Dequindre street.

DEPTH OF WATER PIPE TRENCHES

During the early days of the water works it was customary to lay water pipes with a cover not exceeding 4½ feet. This ordinarily gave but little trouble from freezing for during the mildest winters the frost will not penetrate to a depth of more than 4 feet, and during the more severe winters, as the number of meters on service connections were few, water was allowed to run with but little restrictions.

On September 18, 1919, a resolution was adopted by the board directing that thereafter all pipes laid in unpaved streets should have a cover of at least 6 feet.

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*Prepared from data in the sixty-eighth annual report of the Board of Water Commissioners of the City of Detroit for the year ending June 30, 1920.

PIPE LAYING EQUIPMENT

The board now has the following machinery and equipment engaged in water pipe construction: 2 Buckeye wheel type trenching machines; 4 Austin boom type trenching machines; 1 Austin boom type trenching machine (steam power); 2 6-ton Bucyrus steam cranes; 9 Austin boom backfillers; 2 Oshkosh backfillers, without booms; 1 Buckeye automatic concrete breaker; 1 Buckeye straight drop concrete breaker; 1 Rex concrete mixer; 2 Koehring concrete mixers; 1 Austin 17-foot steam concrete mixer; 1 Ingersoll-Rand portable air compressor; 1 Chicago pneumatic portable air compressor; 1 Sullivan portable air compressor; 1 No. 4 King road grader; 1 3-inch pulsometer with boiler; 1 4-inch pulsometer without boiler; 2 11 x 11 x 12-inch locomotive type air compressors mounted on Bucyrus steam crane; 1 11 x 11 x 12-inch locomotive type air compressor mounted on Austin steam trenching machine; 1 15-ton double truck Browning locomotive crane; 2 20-ton double truck Orten & Steinbrenner locomotive cranes; 4 4-h. p. gasoline Parker mud pumps; 14 3-h. p. gasoline Parker mud pumps; 1 2½-h. p. gasoline Novo high pressure test pump; 1 3-h. p. gasoline driven odorless pump.

The board now owns and operates automobiles as follows: 18 Ford roadsters and light delivery; 1 Ford coupe; 11 Ford 1-ton trucks; 2 Dodge sedans; 3 Dodge touring cars; 10 Dodge roadsters; 17 Dodge commercial cars; 1 Buick ¾-ton truck; 3 Packard 2-ton trucks; 1 Packard 3-ton truck; 1 White 3-ton truck; 2 White 6-ton trucks; 3 Packard 6-ton trucks; 1 Packard 6-ton dump truck; 1 Hall 7-ton dump truck.

The board also owns one traction motor and one 5-ton Holt tractor and five private trucks are rented as needed.

SHOP FOR CONSTRUCTION MACHINERY

Proposals have been invited for the construction of a shop for construction machinery, which will be located in the western yard. This shop will be of brick and steel construction, 90 feet wide by 120 feet long, and will contain an erection floor, blacksmith shop, machine shop, carpenter shop, sheet metal room, stock room and office.

GASOLINE

This department now uses about 140,000 gallons of gasoline for the operation of autos, pipe laying and construction machinery. On April 15, 1919, a storage tank was put in use at the storage yard, having a capacity sufficient to allow gasoline to be purchased in tank cars. This plan has proven very satisfactory, and in addition to this method proving much more convenient and the clerical work having been greatly reduced, there has been a saving of about 2.6c per gallon, or about 10 per cent of the cost of the gasoline.

MAINTENANCE DEPARTMENT

For many years all pipe laying and similar construction work has been prosecuted under the direction of a superintendent of construction, and the management and supervision of the storage yard, leak gangs and men engaged in maintenance work of the distribution system has been in charge of a superintendent of storage yard. On March 1, 1920, a resolution was adopted directing the organization of a maintenance department, in charge of a superintendent of maintenance, to include all work pertaining to the repair of leaks, the maintenance of valves, manholes, gate boxes, the lowering and moving of old pipes and pipes in service, and the laying of new pipes to replace the older and smaller ones.

REPAIRING SERVICE LEAKS

Most of the water leaks in the streets of Detroit occur in the service connections leading into private property. These connections are installed by the property owner and when leaks occur in the same they are repaired by him at his expense. Reports of leaks reach this department and are immediately investigated, and when found to be in the service connection are turned over to the property owner for repairs. Frequently considerable time elapses before repairs are made; in the meantime the excavation in the street is a menace to traffic. It is very desirable that some plan be worked out by which this board may repair such leaks in public streets as it deems advisable, and collect the cost of doing such work from the owner or occupant of the property.

FIRE CONNECTIONS

On September 30, 1920, the board directed that all fire lines installed thereafter should be metered. There are now in Detroit 126 metered and 306 unmetered fire lines.

LEAK SURVEY

In June, 1918, the Pitometer Company, of New York, was engaged to conduct a water waste survey, as follows:

1. Each section was divided into districts and the flow of water throughout twenty-four hours was gauged in each district.
2. Further investigation of all districts where excessive flow was indicated, which resulted in the location of all underground leaks on the mains or services large enough to be measured by the Pitometer Company.
3. Checking up on manufacturing concerns for the purpose of detecting any illegal use of metered water, and testing meters over four inches in place.
4. At the completion of the survey, the report of the work in detail accompanied by charts showing the variation of the flow into each district throughout the twenty-four hours and map showing boundaries of each district and location of all gauging points.

LEAKS DETECTED AND ELIMINATED

The company reported on one section February 2, 1920. This report shows an average daily consumption of 14,681,000 gallons in this section; 1,939,000 gallons per day were found wasting through underground leaks on mains and services from defective connections. These leaks were located and repaired during the time that the waste survey was being made; 2,002,000 gallons per day were found wasting through 1,995 fixtures. These fixtures were discovered by house to house inspection, made by water board inspectors working under the supervision of the Pitometer Company. Notices were left with property owners ordering them to make repairs of any leaks discovered. Ten days to two weeks later another inspection was made and if such repairs had not been made the water supply was cut off at the curb by the boards employees. Seventy-five per cent of the fixture leaks were found on metered services. A few large meters were found stopped, and others under-registering.

In conjunction with this work it was found necessary to locate and operate practically every valve in the section, consequently the valve inspection was carried along with this work. Whenever leaky or broken valves were found they were immediately reported to the storage yard for repairs.

Since the time of the first investigation the Pitometer Company was engaged to continue the work in other sections. The report shows the average daily consumption in Section No. 4 as 10,701,000 gallons; 427,500 gallons were found wasting through underground leaks. These leaks were located and repaired; 3,000.400 gallons were wasting through 1,648 fixtures leaking. Of these fixtures 631 were faucets, 812 toilets, 87 service pipes, 9 hydrants and 109 miscellaneous fixtures. The fixture leakage in this section was approximately 42 per cent of the total subdivision night rate flow; 78 per cent of these fixture leaks were on metered services.

PIPE LINE EXTENSIONS ON PETITION

Ordinance No. 701-A allows any lot owner to petition for an extension of water main upon payment of 25 cents per foot frontage of his lot. After this petition is received, a map is prepared showing the proper size of main and amount of pipe necessary to supply this lot. All lots fronting on this extension are assessed 25 cents per foot frontage and a resolution is adopted by the board of water commissioners ordering such extensions. No property owner whose lot fronts on this extension is allowed service connection until he has paid his assessment.

CONSTRUCTION COST OF MAINS

Showing cost of mains of various sizes, material, labor, overhead expense and power machine expense.

Size	No. of Feet	Material, Etc.	Labor	Overhead Expense	Power Machine	Total
6 in.	273,684	$338,884.49	$144,611.74	$44,559.32	$33,058.94	$561,074.49
8 in.	243,050	432,168.42	188,200.25	49.574.33	29,206.10	699,149.10
10 in.	2,370	5,509.52	3,038.01	697.24	134.56	9,379.33
12 in.	24,957	75.055.57	36,344.00	8,418.45	2,151.56	121,969.58
16 in.	8,312	36,025.91	10,510.87	2.526.58	5,636.39	54,699.75
24 in.	9.573	73,921.10	21 698.00	6,089.07	8,558.26	110,266.43
30 in.	4,712	55,756.45	27.229.90	6,403.98	2,611.23	92,001.56
36 in.	2,228	45,268.26	32,881.63	12,528.34	2,912.43	93,590.66
42 in.	3,225	76,908.56	14,007.22	3,689.98	4,436.73	99,042.49
48 in.	4,401	129,620.73	22,281.02	4,679.01	7,532.98	164,113.74
Totals	756 606	1 269,232.68	500,994.76	139,204.72	96,239.18	2,005,671.34

During the year there were 75 breaks in mains, five of them being in pipes 24 inches or more in diameter.

Uniform Cost Accounting

How far may a trade association go in a uniform cost accounting system?

In putting this question to the acting chairman of the Federal Trade Commission, the Fabricated Production Department of the National Chamber of Commerce made this explanation:

"We refer to a standard plan or methods which may be developed and used by the producers of a certain line whereby they figure their costs by the same rules, including in them the same elements and differing only in results because of the variance in size of plants, equipment and local conditions—uniform as to fundamentals.

"Is there any reason why such a system may not be developed and used lawfully by an industry? Again, if conversion costs only be dealt with, is there any legal bar to the collective study of costs by the members of an industry using such a uniform cost system?"

The reply, made unofficially, is that such a collective study is not only permissible but beneficent so long as no ulterior use of it is intended. At a time when the trade associations are in considerable perplexity as to what course of conduct they may pursue, this clarification of the cost accounting problem should prove extremely helpful.—

Steel Erection Precautions

Cause and prevention of a majority of accidents occuring during the building of tall steel structures. Temporary bracing and careful supervision of construction loads of great importance.

In most cases the stability of a roof, especially one with trusses, is, as well as a building frame, very different during erection and after completion of the building. During erection the framework of the building is likely to consist only of skeleton members that are not able to develop their full strength because of the absence of supplementary portions of the structure like walls, floors, roof surface, and other elements that tend to hold the principal members firmly in position, prevent their displacement or deflection, and are able to offer large resistance to wind pressure and vibration.

It is, therefore, true that well-designed and well-built roof trusses, columns and other steel structures that are fully adequate to carry the working loads for which they are proportioned, may be entirely unable to resist comparatively small temporary stresses developed during erection.

TEMPORARY BRACING

This fact is so well recognized by careful designers that some of them insert extra members in the way of special braces to care for erection stresses that although left permanently in the structure, are no longer necessary after its completion. This, however, is unnecessary if reliance can be placed on the erector to make temporary provision for the stresses and conditions possible during the construction of the building.

Steel trusses, platforms, tanks or bins supported on tall steel columns may be subject to very dangerous overloads during erection, through wind pressure, temporary loadings, hoisting stresses, imperfect connections and ordinary field accidents that might be safely sustained by the finished structure but that cannot be resisted by the incompleted structure.

Usually even very slender columns and light trusses and girders can sustain heavy loads, without impact, if they are symmetrically applied and if the columns, girders and trusses are properly adjusted and maintained in perfect alignment and position. This condition is promoted by the general custom of thoroughly guying or bracing long columns and trusses as fast as they are assembled together and by avoiding heavy loads on them unless special provision is made for their support and distribution.

The principal framework of steel structures frequently consists of transverse bents made up of a long span light truss and two vertical columns that, considered as an independent bent, has little stability. Roof trusses having comparatively small working loads to sustain are likely to be very slender and liable to buckle so that sometimes it is necessary to temporarily stiffen them by timber or other reinforcement lashed or bolted on to enable them to be safely handled in erection, although later they may be thoroughly and permanently stiffened with connecting braces and with the roof surface.

LONGITUDINAL X-BRACING

The framework of a steel building, with or without truss roof, is generally erected in transverse vertical bents and if the work is done so rapidly that proper bracing between them is omitted, a failure of any part of the building is likely to be progressive and the collapse of one bent may be transmitted throughout the entire building and cause the fall of the whole. This is very easily prevented by the simple expedient of bracing the bents together with longitudinal vertical X-bracing either permanent or temporary. The omission of such bracing, unless the permanent walls and roof are erected as rapidly as the bents themselves, is nothing short of criminal and always invites disaster, which often responds.

A large majority of the serious accidents during the erection of steel frame buildings are due to the omission or imperfection of longitudinal X-bracing that virtually should transform the separate weak independent sections to a combined whole that possesses multiplied strength equivalent to that of a great truss. The use of longitudinals alone to connect the successive bents is probably seldom or never omitted but of itself is inadequate if they serve merely to transmit the stress from one bent to another which if sufficient to cause the collapse of one bent may cause the collapse of all.

IMPROPER CONSTRUCTION LOADS

Another serious erection danger is in the careless or ignorant application of an undue load to a truss or floor, or to a load improperly applied or in the wrong position. Trusses are often so designed that, in the finished structure they can scarcely be overloaded under ordinary conditions while in the unfinished structure a very moderate load may be sufficient to destroy them.

A shed roof in California was built with wooden trusses that, during erection were overloaded with building materials not placed in the proper position, that caused its collapse. This accident was not investigated and was followed by a similar one about a week afterwards which caused the destruction of a 74-foot span truss and caused the death of one man and serious injury of another. This accident was entirely preventable and inexcusable and in commenting on it, the California Safety News published by the Industrial Accident Commission of the state of California very pertinently says:

"Both failures were due to unsymmetrical loading. The truss that failed, causing the second collapse, was 74 feet in span and had no counter or knee bracing. No allowance was made for stiffening and bracing the long trusses of this structure during construction.

The following precautions, if observed, will prevent a recurrence of such a collapse:

1. All long trusses shall be reinforced with counter and knee bracing.
2. No truss or roof member shall be loaded until the truss is completely bolted and all purlins and braces connected.
3. In the case of light trusses having no purlins, temporary struts shall be securely fastened to the top and bottom before the truss is loaded.
4. Concentrated loads placed during construction shall in no case exceed 3,000 pounds, or 1,000 feet board measure of lumber.
5. For short trusses where the derrick or loading device can distribute the load over the entire truss, the load shall not exceed the total amount of the roof sheathing supported by the member in the finished structure.
6. All sheathing shall be evenly and symmetrically distributed across the entire truss with not more than one-third of the load in the middle of the truss.
7. For long trusses where the derrick or loading device cannot reach over the entire truss, the load shall be distributed across the middle of half the truss and shall not exceed two-thirds of the total amount of the roof sheathing supported by the member in the finished structure. The loads shall at all times be symmetrically placed.
8. All loads shall be evenly spread in laying the roofing on either side of the center line and unsymmetrical loading shall be avoided.
9. If concentrated loads are required after the roofing has been spread, they shall be placed only over the posts at the ends of the trusses."

PUBLIC WORKS

Published Weekly
by
Public Works Journal Corporation
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba. $3.00 year
All other countries .... $4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

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FRANK W. SKINNER, Associate Editor

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An Economical Municipal Investment

The description on page 199 of the extensive water main system and its construction and maintenance facilities for the city of Detroit, is of especial interest as illustrating the systematic organization and abundant equipment provided for the extension, maintenance and operation at a cost of more than $3,000,000 per year of the water distribution in a large city. It has a cost of approximately $66 per million gallons of water used.

The cost is undoubtedly materially reduced, efficiency increased and much greater promptness secured by the provision of a city construction plant containing 42 major items of equipment besides 22 pumps and pulsometers and 75 automobile cars and trucks. This plant saves a large sum in the cost of trenching and backfilling, grading and transportation and, being available night and day, is much more reliable than the increased number of laborers that would be necessary to perform the same work with less equipment. The systemization of operations and the prompt discovery of breaks and leaks and their elimination also makes for ultimate economy.

Obviously the same details cannot be advantageously adopted in all other cities, but it is well worth while for every municipal water works department to make a careful survey of the conditions, analyze resources and requirements and plan for a comprehensive installation best suited to handle all major operations in a standard manner and with a maximum of improved labor saving equipment.

Remedies for Important Erection Dangers

The collapse of structural steel work during erection is one of the most common of serious construction accidents. It is always preventable and no matter how faulty the design of the finished structure the accidents are always unnecessary and generally due to gross carelessness or ignorance in field operations.

The three most common causes are the lack of sufficient bracing; inadequate or imperfect fitting and bolting; and improper loading. It would be impossible for most steel or iron structures to collapse as a whole during construction if they were properly X-braced.

The strength of a truss or important member may be greatly reduced by badly fitted and adjusted splices or by a deficiency of connection bolts.

There is great danger in imposing heavy loads before the structure is ready to receive them, even if it will eventually be amply strong to support them.

There is still more danger in locating heavy concentrated loads at improper points and especially in unsymmetrical and unbalanced loadings as by the accumulation of large quantities of building material in temporary positions.

Excessive strains may be transmitted from derricks in service and any large force that is suddenly or violently applied has a greatly increased destructive effect.

The rules given on page 202 for roof construction are good as far as they go and should always be observed besides additional ones, according to conditions.

All steel structural work and all derrick systems, bracing and guys should be carefully inspected night and morning and safety precautions rigidly maintained.

Construction Equipment of Universal Utilities

The description on page 206 of the use of gallows frames for the erection of girder spans is a specific consideration of an appliance very common in the special work of bridge erection that is thoroughly applicable to a great number of construction purpose. There is hardly an important piece of construction work but that requires lifting, shifting, or handling of heavy pieces of machinery, large stones, castings, or other weighty objects often in places or under conditions where it is difficult to provide derricks, cranes or other mechanical apparatus for that purpose.

In a large number of such cases the gallows frame or a modification thereof can be economically and conveniently used. Its advantages are great and its disadvantages few. It is a simple device; requires no careful design or proportioning. With a few timbers, ropes and pulleys an apparatus can be made that will handle very heavy and bulky objects, raise or lower them, load or unload them, place them on rollers, or even move them several feet in longitudinal or transverse directions quickly and safely. The gallows frames can be made and erected in almost any situation by unskilled labor, using universal materials that have full salvage value after the work is completed.

Desirable Cost Accounting

The inclination of some large interests to violate Federal laws by trust and price fixing combinations and arbitrary control of commercial operations has called for and received investigations, and penalties have been in some cases imposed, the consideration of which have raised the question of how much combination and co-ordination is permissible in accounting systems.

A formal inquiry by the National Chamber of Commerce has elicited the authoritative, but unofficial opinion published on page 201 that, properly used, uniform forms of cost accounting are not only permissible, but desirable. It is, of course, in accordance with common sense, good judgment, and good business, that contractors engineers, constructors, city officials and others interested in building and engineering construction should be encouraged to strive for improved classification of costs and for the adoption, as far as possible, by different recorders, of a uniform system of accounting that will produce comparable results in different localities under different conditions and by different recorders. These should be of great value to all designers and estimators and can be exchanged and disseminated through technical societies, chambers of commerce, and other municipal or private organizations so as to benefit the public at large, constructors and to the general advantage of the art.

It would be well for the different organizations of these interests as well as for the technical societies to appoint special committees to investigate and report with recommendations of action to secure a code of standard practice in classification, and unit costs or at least of a tentive recommendation that may be gradually extended, perfected and adopted.

Such a system should of course be prepared on broad lines with carefully prepared divisions, definitions and explanations so that there should be sufficient data to indicate all special and irregular features and enable the principal results to be reduced to a common denominator.

Concreting Large Stock Bins

A compound spouting installation for constructing the Franklin bins for the Cambria Steel Co., in a long, restricted area by continuous operations, uninterrupted by any necessity for shifting plant.

The construction of the large depressed Franklin stock bins for the Cambria Steel Co., Johnstown, Pa., involved distribution over the work and the delivery to forms of approximately 8,000 yards of concrete that was handled entirely by gravity with a system of hoisting towers, suspended chutes and revolving chutes, designed, fabricated and installed by the Ransome Concrete Machinery Co.

This system eliminated practically all hand work and the use of cars, industrial tracks or moveable apparatus and permitted the concrete to be advantageously mixed at the fixed central point and automatically distributed from this point as required to any part of the work without the use of moving equipment other than the hoisting buckets and swinging chutes. The use of revolving chutes operated by gravity and easily installed derricks, developed great flexibility and wide limits for the application of the cable suspended and counterbalanced chutes. The fact that at the derrick the chute was pivoted to the mast and at both ends of an intermediate trussed section supported on a balanced cantilever, made all portions of the area commanded easily accessible, permitting the discharge to be rapidly shifted from point to point and to be moved forward in zig-zag operations, covering the entire areas as it advanced.

TOWER, DERRICK AND CABLE ARRANGEMENT

The aggregate was delivered to the foot of a steel hoisting tower A, originally 140 feet high, that had been extended by a height of 40 feet; it was mixed in a Ransome 1-yard machine, continuously hoisted to the top of the tower A, and dumped into a hopper, discharging into steel chute 350 feet long, suspended from a cable attached to the top of tower A and reaching to a point near the bottom of tower B, where the chute delivered through a receiving hopper to a second hoisting bucket of 36 cubic feet capacity, that elevated the concrete to the top of tower B 195 feet high, where it was discharged into a receiving hopper, or to an intermediate point where it was discharged into another receiving hopper about 125 feet above the ground. Both tower hoppers were, however, mounted to slide vertically so as to be quickly set at different elevations if required.

From each hopper on tower B there extended an inclined chute suspended from a cable attached to the tower a few feet above a hopper and at the tower and attached to the guyed top of a derrick mast. All the masts were located so that it was possible to swing the chutes in circular arcs commanding a wide area, even larger than was required for the work in progress.

The upper chute from tower B had a maximum length of 320 feet and the lower chute a length of 128 feet.

COUNTERBALANCED REVOLVING CHUTES

The lower ends of both chutes delivered to hoppers attached to the masts, through which the concrete was discharged into chutes that revolved around the masts. Each of these chutes was made in three sections, the upper end of the first section being pivoted to the mast just below the hopper and the lower end pivoted to an intermediate section about 48 feet long supported on the top chord of a counterbalanced cantilever truss that was suspended from the end of the derrick boom.

The lower section 32 feet long, of the revolving chute, was pivoted to the end of the intermediate section, and was supported at the bottom on the side of the form or on a trestle or other convenient bearing near the point where the concrete was to be discharged. A similar derrick and a three-part revolving chute was installed at about the middle point of the cable suspended chute delivering concrete from tower A to tower B, so that concrete could be diverted from this chute to the revolving chute below that commanded all of the area between towers A and B, while the two revolving chutes first mentioned commanded all of the area between tower B and the farther extremity of the work.

The continuous line chutes were all made in standard sections 32 feet long and those supported by the cables were suspended from it with 4-part manila tackles 32 feet apart on centers, attached to trolley hangers clamped to the cable.

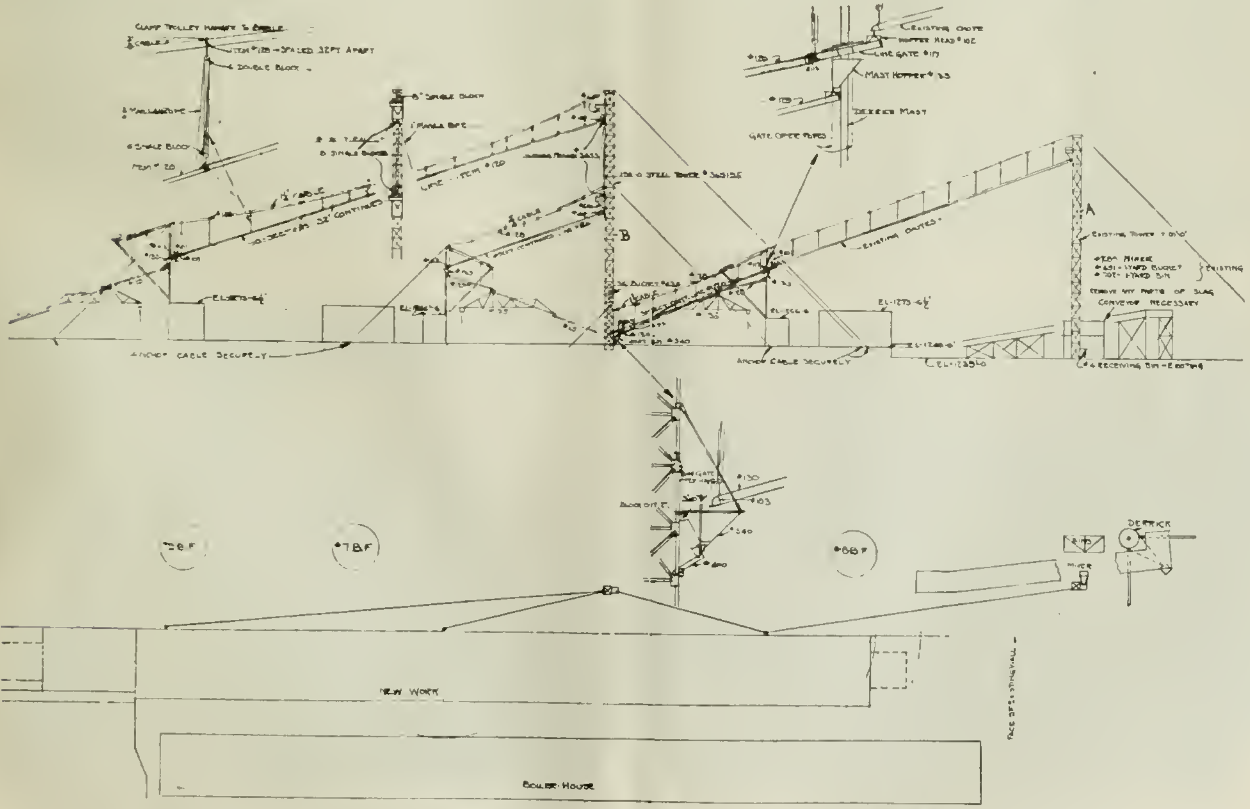
The steel tower hoppers of 40 feet capacity, were standard Ransome type, suspended by 3-part tackles, enabling them to be easily adjusted for any required height.

The entire concrete plant required for its efficient operation 12 men, including those at the mixer, and exclusive of those who spread the concrete after it was deposited in the forms. The greatest distance from the concrete mixer at which the concrete was deposited was 810 feet and it was all placed at or below ground level.

The plant had an estimated capacity of 40 yards per hour, limited only by the nominal capacity of the mixer. The slope of the chute averaged 1 in 3, being sufficient to assure a continuous flow of the concrete without obstruction, so that it was not ordinarily necessary for attendants to scrape or clean the chutes. The hoppers were provided with gate valves at which attendants were stationed to cut off the flow temporarily if needed, and to regulate it. All the concrete plant was standard Ransome equipment, easily installed and removed, portable for use for general construction operations and possessing high salvage value after completion of job.

The essential feature of this plant was the location of the three derricks so that their radius of operation covered the entire length of the work to be done without any shifting of the derricks or of the cables suspended to chutes.

The plant once set up, the concreting could take place continuously without any stop for shifting chutes or changing forms. It was estimated that 11 days of continuous pouring would complete the job. This work was in very restricted quarters between a line of blast furnaces on one side and a boiler house on the other and when work had once been commenced it had to be carried through in the shortest possible time.



ESTIMATOR'S DIAGRAM OF CONCRETE SPOUTING SYSTEM SUSPENDED FROM HOISTING TOWERS AND GUYED DERRICKS, ARRANGED TO COMMAND LONG, NARROW AREA FOR MAXIMUM RAPIDITY OF DISTRIBUTION

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Handle and Erect Girder Spans Without Special Equipment—VI*

With gallows frames.

When derricks, derrick cars or their equivalent are not available one of the most popular means of unloading, loading and erecting long and heavy girders is by means of a pair of gallows frames, from which tackles are suspended to raise and lower the girder and to shift it if necessary a few feet longitudinally or transversely.

The principal advantages of the gallows frames are that they are of very simple design and easily, quickly and economically constructed from almost any available new or second hand timber; that they are very strong and can handle large weights safely; that they can be given great stability; that they can be very easily and quickly erected; readily shifted from place to place; and can easily be arranged to clear all obstructions and to avoid any interruption of traffic or impediment of train service.

PRINCIPAL FEATURES

A gallows frame consists substantially of a horizontal cap supported at each end on the top of a vertical post. It may be made of any convenient dimensions, usually from 10 to 30 feet high with vertical posts from 5 to 30 feet apart. The vertical posts should be of the same length at both ends, cut square, and the transverse part should have full bearing on the posts and be connected to them with scabs bolted to cap and posts. They are usually made out of square timber, 6 x 6 inches and upwards, and the caps should be knee-braced to the posts. If extreme clearance through the gallows frame is required the caps may overhang the posts and have the braces on the outside of the posts, otherwise it is better to put the braces on the inside of the post, thus strengthening the cap as a beam; continuing the braces to a point at or near the center of the cap greatly increases the strength of the latter. A pair of gallows frames made of 12 x 12-inch timber throughout, with the caps knee-braced near the center if their length is great, or made with two timbers, one on top of the other, are strong enough to handle any girder that is likely to be erected.

Each gallows frame should be secured by a pair of transverse guys in opposite directions attached to each end of its cap and, of course, properly

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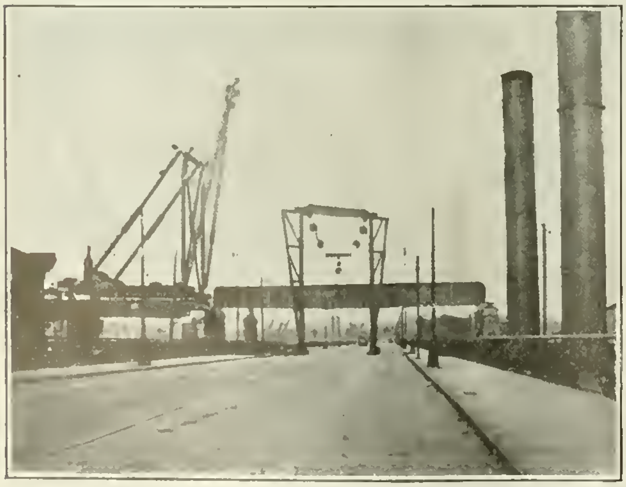
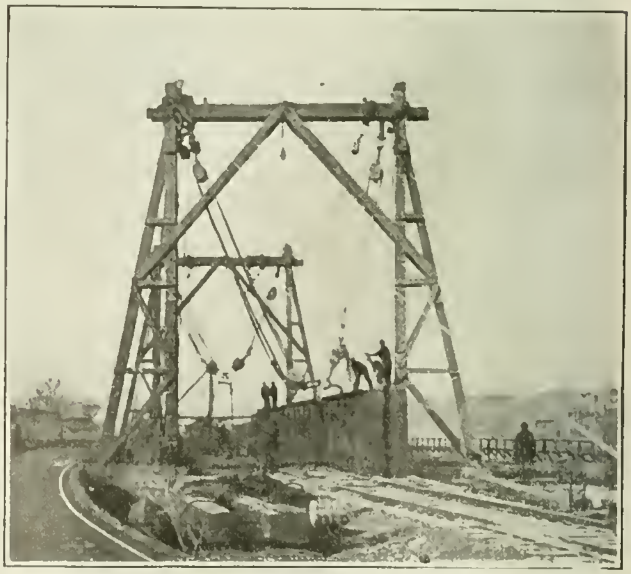
*Part I.—Transportation to site and erecting by steam protrusion was published July 3.
Part II.—Erection by cribbing, jacking, rolling and skidding was published July 30.
Part III.—With fixed derricks was published August 6.
Part IV.—With locomotive cranes, derrick cars and wrecking cars was published August 13.
Part V.—With locomotive cranes, derrick cars and wrecking cars, was published August 20.



ERECTING PLATE GIRDER WITH GALLOWS FRAME SET OBLIQUE TO BRIDGE AXIS



UNLOADING, FLEETING AND ERECTING GIRDERS WITH TRUSSED GALLOWS FRAMES anchored at as flat an angle as possible. In some cases, particularly where a great deal of work is to be done with the gallows frame in the same position or with frequent short removals, and they are not too far apart, they may be connected by longitudinal timbers and bracing, thus forming a rectangular skeleton tower that will be stable without guys. If seated on soft ground the lower ends of the vertical posts should rest on sills.

Each gallows frame must be provided with a tackle suspended from any point of the cap between the vertical posts and operated by a hand windlass or hoisting engine.

METHOD OF USE

For unloading girders from railroad cars the gallows frame generally should have both horizontal and vertical clearance for trains on one, two or three tracks, as may be required. They are generally set up transverse to the track over which they operate, but if clearance is limited or if necessary for any other reason, they may be placed with their caps oblique to the tracks served.

The car from which the girder is loaded is run under and through the gallows frames, a tackle from each gallows frame is attached to the nearest end of the girder and operated sufficiently to lift it clear of the car, which is then removed and the girder can be lowered directly to trucks or rollers underneath, or lowered to the ground.

Usually the gallows frames are separated by a distance slightly less than the length of the girder so that both ends of the girder project slightly beyond the gallows frames, but the frames may be put each within a few feet of the center of the girder on opposite sides of it, or they may be a short distance beyond the end of the girder if circumstances require it or the girder may be swung and lowered to different positions relative to gallows frames located in the usual manner for unloading it.

The girder may be shifted longitudinally in the tackles by swinging them to inclined positions before they are connected to the girder and then slacking off on one tackle as the other tackle is operated when the girder is suspended freely in them.

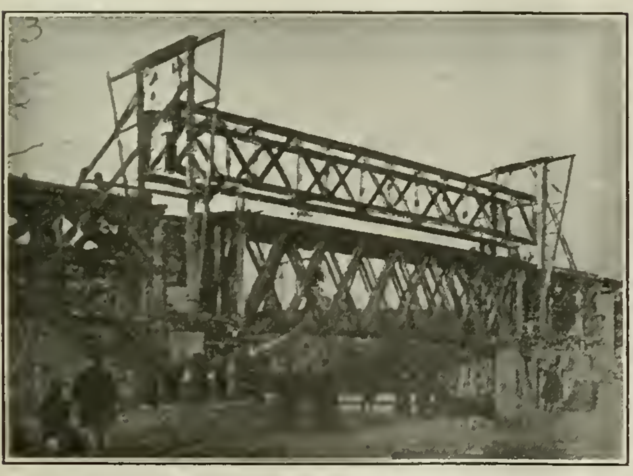
Similarly the girder may be shifted transversely by swinging it in the tackles. In order to swing it any considerable distance either longitudinally or transversely, one or two additional tackles are required and the operation is known as fleeting. A girder can easily be fleeted across the full width between the vertical post of a gallows frame by means of two pairs of tackles both suspended from the ends of the caps of the gallows frames. Both tackles of each gallows frame being attached to the girder near the ends and set up tight so as to suspend the girder, one tackle is slacked off while the other is operated and pulls the girder across the full width, or any part of it, of the horizontal opening in the gallows frame.

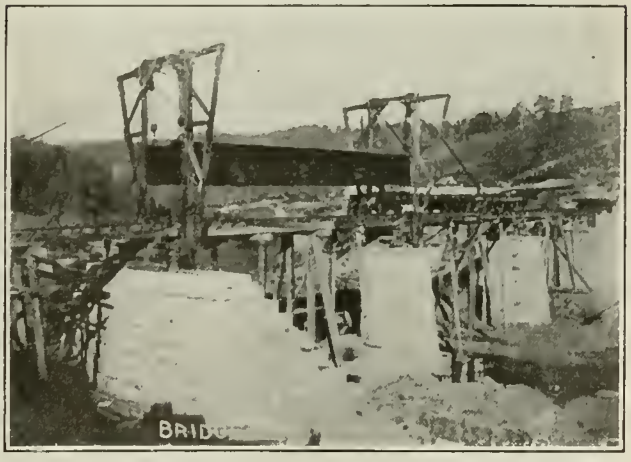
Complete single track railroad spans consisting of a pair of girders with their cross bracing, can readily be set on flat cars, run over the old bridge to required position, lifted from the cars and held suspended from the gallows frames while the cars are run off from the old bridge, the old spans torn down and removed, and the bridge seats adjusted to receive the new spans which are lowered to place on them without moving the gallows frame.

On the Chicago-Milwaukee & St. Paul Railroad, where it was at one time necessary to handle all girder spans of more than 75 feet with gallows frames, a pair of 40,000-pound plate girders were erected by two gallows frames in 45 minutes.

A wooden Howe truss span across Walnut creek, Ohio, was replaced by a steel span having two 91-foot plate girders, 9 feet deep, that were unloaded from cars at the site by a gallows frame with four tackles at each end which held the girders suspended while the cars were removed, the old wooden trusses stayed by lateral braces, and the old floor and cross bracing removed, permitting the new girders to be lowered to position on the substructure, a new floor built on them and traffic resumed, after which the old trusses were removed at leisure.

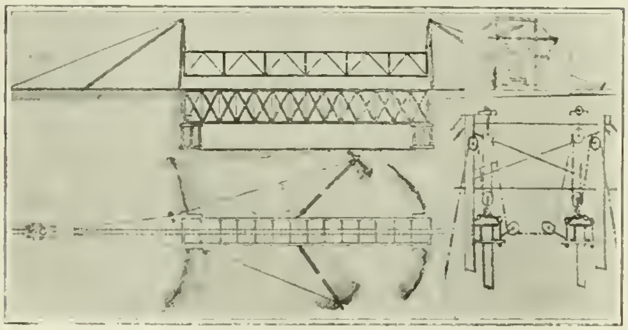
In the erection of a new bridge with heavy plate girder spans supported on masonry piers and abutments, the girders were delivered on a service track laid on a temporary wooden falsework tres-


ERECTING COMPLETE LATTICE GIRDER SPAN AND REMOVING OLD SPAN WITH TWO GALLOWS FRAMES



ERECTING COMPLETE PLATE GIRDER SPAN WITH FALSE-WORK AND TWO DOUBLE-POST GALLOWS FRAMES tle built between the piers and were unloaded by gallows frames seated on the pier tops. The gallows frames were of special construction with outside batter posts and 2-piece caps with their ends separated about 4 feet at the center of the gallows frame and connected by a top splice timber with long bolted overlaps. The end pieces of the cap served as corbels, supporting the heavy center piece of the cap that reached a little beyond the vertical post at each end, and was thoroughly bolted on the corbels. The girders were delivered in pairs, riveted together with their cross-pieces, making complete spans that were handled by two heavy tackles at each end by which they were lifted from the cars and the latter removed, after which the falsework also was removed and the girders lowered to position by the tackles.

A wooden Howe truss bridge in Canada was replaced by a pair of iron latticed girders riveted together and shipped and erected as a unit. The cars bringing the new span were run over the old span and the new span was unloaded by two tackles at each end suspended from the trussed caps of the gallows frames.



ERECTING 98-FOOT SPAN AND RAZING OLD SPAN WITH BRACED AND GUYED GALLOWS FRAMES, LOCOMOTIVE AND ANCHORED TACKLES

These gallows frames were trussed on the outside of the vertical post and each was equipped with the two tackles rove with the same line, each end of which was carried to a hoisting engine drum, thus securing equalized strain throughout the entire funicular system.

On account of the great weight of the span it was lifted slightly by jackscrews, the tackles set up tight and the screws removed, leaving the spans suspended from the gallows frames and permitting the withdrawal of the cars. The transverse bracing in the old bridge was cut away and the tackles, anchored at the lower ends, were attached to the middle of the top chords of the old trusses and their lines being lead through snatch blocks were connected to a bridle made fast to a locomotive engine that, pulling on them, overturned the old trusses and dragged them along the bed of the stream, where they were dismembered at leisure. The new trusses were then lowered to their permanent position in the substructure and traffic on the new span was resumed after an interruption of only 6½ hours, of which 2 hours were required to swing the new span with the gallows frame, one hour to prepare the old bridge, 15 minutes to demolish it and 45 minutes for lowering and setting the new spans.

The job required 224 single days' work performed by a gang of 11 men in twenty-two days when the mercury was 40 degrees below zero. The total cost of the work, including $14 for fuel, $40 for locomotive rental, and $148 for superintendent's salary, was only $898, equivalent to $22 per ton.

To Be Continued

Sand-Clay Roads in North Carolina

The progressive policy of road building and maintenance in North Carolina is emphasized by the recent $50,000,000 bond issue and by $10,000,000 worth of work projected for the current year, much of which will be sand-clay road construction and fall grading on lines that will be paved with concrete next year.

The amount and rapidity of the work is greatly increased by the approach toward pre-war conditions, which have reduced prices so that while $.60 per yard is being paid for some road grading now nearing completion only $.30 is paid on new contracts, some of which, however, will probably show a loss that has been accepted in some instances in order to provide work for large numbers of idle teams.

In this state the sand-clay roads costing about $4,500 per mile, are surfaced with naturally mixed material, which, in many cases, is found so close to the road that it may be handled with wheeled scrapers. One of these can deliver about 100 cubic yards per day when the haul is not more than 300 feet. Above 1,000 feet 3 cents a yard is allowed for overhaul. The sand-clay is spread on the road surface with a blade grader and crowned about 12 inches. J. T. Plott, Greensboro, has contracts in several counties aggregating 117 miles on which he employs a total force of more than 300 mules.

$7,366,314.20 Spent for Texas Highways

According to the Texas State Highway Department, 130 new road projects have been completed involving 1,106.1 miles at a total cost of $7,366,314.20, on which $1,312,258.85 State Aid and $1,794,335.14 Federal Aid was paid. Of these roads 32.4 miles were paved with concrete, 142.5 miles with bituminous materials and 607 miles with gravel. There are now under construction 192 projects involving 2,300.8 miles at a total cost of $26,955,348.03, and upon which sums of $9,260,986.09 as Federal Aid and $2,296,217.61 as state aid have been granted.

Of these projects, 83.7 miles are paved with concrete and 421 miles with bituminous materials. Seventeen other projects totaling 144.2 miles are not yet under contract. Ten additional contemplated projects are not yet approved, while sixty-five more have been approved for Federal Aid to the extent of $2,697,078.84 and State Aid to the amount of $1,208,740.52.

Recent Legal Decisions

STREET RAILWAY COMPANY MAY BE COMPELLED TO PERFORM CONTRACT TO BRING THE TRACKS UP TO CHANGED GRADE AND PAY EXPENSE OF PAVING

In a suit to compel a street railway to bring its tracks to grade and complete the pavement required by a change of grade at street intersection on changing from an earth road to a paved street and for the expense caused by its failure to do so, the Pennsylvania Supreme Court holds, Borough of Sayre v. Waverly, Sayre & Athens Traction Co., 113 Atl. 424, that equity has jurisdiction to compel a street railway company to specifically perform its contract with the municipality for the making of street improvements; and, having obtained jurisdiction for that purpose, it will, to prevent a multiplicity of suits, grant complete relief by ordering such company to pay the loss its failure of performance caused the municipality. The street railway company's financial embarrassment and difficulty in procuring material and labor were held to constitute no legal excuse for failure to perform its contract; and its alleged inability to procure new rails was entirely without merit, as the city offered to permit the company to use the rails then in place.

As the street crossings affected were all on the ground long before the pavement was started, and there was no attempt or intention of establishing, abolishing, relocating, or substantially changing the grade of any crossing; the case did not fall within the jurisdiction of the Public Service Commission. "A municipality is not required to get the consent of the commission before it can make an inconsequential change of a few inches in the grade of its existing street intersections, rendered necessary by a street improvement, although there may be a railway track upon the street so improved. This is especially so where, as here, the railway company is under contract to conform the grade of its track to that of the street as the municipality may establish it."

ZONING ORDINANCE HELD NOT AUTHORIZED AS NOT APPPLYING TO ALL WITHIN ZONE

In a suit by a village to restrain the erection of a public garage in violation of a zoning ordinance forbidding infringement "without a special permit to be granted only upon resolution of the board of trustees and after a hearing," it is held, Village of South Orange v. Heller, New Jersey Court of Chancery, 113 Atl. 697, that such an ordinance is invalid under New Jersey P. L., 1920, p. 455, the power delegated to municipalities by that statute being to fix zones within which certain supposedly obnoxious businesses are not to be carried on and buildings intended for these purposes are not to be erected, and the restrictions imposed are to be uniform and obligatory upon all persons and property alike throughout the zone. The discretionary powers reserved to the trustees by the ordinance to give to one and withhold from another the privilege of violating the ordinance is not conferred by the act.

STATUTE DECLARING MUNICIPALITY NOT LIABLE FOR FAILURE TO FURNISH WATER TO EXTINGUISH FIRE HELD VALID

The North Carolina Supreme Court holds, Mack v. Charlotte City Water Works, 107 S. E. 244, that the state statute, Section 2807, C. S., which provides in part as follows: "The city may . . . maintain its own light and water works system to furnish water for fire and other purposes, and light to the city and its citizens, but shall in no case be liable for damages for a failure to furnish a sufficient supply of either water or light," is well within the legislative powers to the extent that it applies to "official acts, governmental in character, or for the benefit of the public generally." and under this statute a municipality is not liable for failure to furnish an adequate water supply to extinguish a fire and save the plaintiff's building.

MISSISSIPPI ROAD COMMISSIONERS HELD WITHOUT AUTHORITY TO LET CONTRACTS UNTIL ENGINEER'S REPORT ADOPTED AND RATIFIED

The Mississippi Supreme Court holds, Ellis v. Tillman, 88 So. 281, that the provisions of Section 5, Chapter 176, Laws of 1914, providing for the appointment of road commissioners and requiring them to employ a competent engineer to survey and lay out such road or roads as should be selected by such commissioners to be constructed and maintained, and making it the duty of such engineer to make an estimate of the cost of constructing and maintaining such highway for each separate mile covered by such survey, and to report the survey and estimate to the commissioners before contracts are let for the construction, or the construction and maintenance of such roads, are mandatory, and until such survey and estimate have been filed and adopted by the commissioners and ratified by the board of supervisors, the commissioners are without authority to let contracts for the construction of such roads.

CITY MUST HAVE NOTICE OF SUBSEQUENT DEFECT AFTER REPAIRING DEPRESSION IN STREET

A city cannot be charged with notice of a defect in a street caused by a depression which has existed only a few hours before an accident, the excavation not having been made by the city. An excavation was made under a license issued by a city to a plumber for the purpose of making a sewer connection for a new building. The excavation had been twice fully repaired and inspected by the street commissioner on the morning of the accident. It was held, Strang v. City of Kenosha, Wisconsin Supreme Court, 182 N. W. 741, that "in order to charge the city, notice of the defect which caused the injuries must be brought home to it in some way. The city, having once repaired the street at the place in question, in order to make it liable, must have notice, actual or constructive, of a subsequent defect, and a reasonable opportunity to repair."

NEWS OF THE SOCIETIES

Sept. 7-9—LEAGUE OF VIRGINIA MUNICIPALITIES. Annual convention. Secretary, L. C. Brinston, Portsmouth, Va.

Sept. 12-17—NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES. Seventh exposition. Eighth Coast Artillery Armory, New York City.

Sept. 12-17—NATIONAL ASSOCIATION OF SANITARY ENGINEERS. Evansville, Ind.

Sept. 12-26 — AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS. Wilkesbarre, Pa.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary. Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 14-15—ASSOCIATED BUILDING CONTRACTORS OF ILLINOIS. Semi-annual meeting. Danville, Ill.

Sept. 19-21—ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA. Chicago, Ill. Secretary, P. J. McAndrews, C. & N. W. Ry., Sterling, Ill.

Sept. 19-23—INTERNATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONER. Chicago. Secretary, Ethelbert Stewart, U. S. Bureau of Labor Statistics, Washington, D. C.

September 19-24 — ASSOCIATION OF IRON AND STEEL ENGINEERS, La Salle Hotel, Chicago, Ill.

Sept. 22-24 — NATIONAL DRAINAGE CONGRESS. St. Paul, Minn.

Sept. 23—AMERICAN SOCIETY OF MECHANICAL ENGINEERS, METROPOLITAN SECTION. Engineering Societies Building, New York City.

Sept. 26-30—ILLUMINATING ENGINEERING SOCIETY. Rochester, N. Y. Illuminating Engineering Society, Chicago Section, Chicago with National.

Sept. 26-30— NATIONAL SAFETY COUNCIL. Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventth annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 5-7—SOCIETY OF INDUSTRIAL ENGINEERS. National convention. Springfield, Mass.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 12-14—LEAGUE OF KANSAS MUNICIPALITIES. Annual convention. Lawrence, Kans. Secretary, John G. Stutz. University of Kansas.

Oct. 20-21—CITY PAVING CONFERENCE. Engineers Club of Philadelphia, 1317 Spruce St., Philadelphia. H. E. Hopkins.

Oct. 20-21—OHIO STATE CONFERENCE ON CITY PLANNING. Annual conference. Columbus, Ohio. Secretary-treasurer — Charlotte Rumbold, Chamber of Commerce Building. Cleveland.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-16—CITY MANAGERS ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

Nov. 16-18 — NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

ASSOCIATED BUILDING CONTRACTORS OF ILLINOIS

It was decided at a special meeting of the executive committee of the Associated Building Contractors of Illinois, held on July 18, that the semi-annual meeting of the association be held September 14 and 15 at Danville, Ill. Plans were made for a two-day session and it is said that the program will include a number of interesting subjects, among which will be "Present Building Costs and Conditions," "Rates of Wages as Compared with Cost of Living," "What Can Be Done to Encourage and Stimulate Construction Work?" "The Relationship as Between the Contractor and the Materialman," "The Compensation Law," and others.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS

At the fifteenth annual convention of the Association of Iron and Steel Electrical Engineers which will be held in Chicago on September 19-24, papers of particular interest will be presented. Special stress and emphasis will be given to steel mill problems and steel mining practices in papers prepared by men who have devoted years to the study and operation of electrical application and steel making processes. Chairman of the following committees will also present papers on these subjects: Education, Standardization, Safety and Electrical Development in Steel Mills.

CITY PAVING CONFERENCE

A meeting for the discussion of city paving will be held in Philadelphia, October 20th and 21st, 1921, under the auspices of the Engineers' Club of Philadelphia, with the co-operation of the Department of Public Works, Bureaus of Highways and Surveys of Philadelphia; Civil Engineering Dept., University of Pennsylvania; Philadelphia Chamber of Commerce; City of Baltimore Paving Commission; Department of Public Works, Borough of Manhattan, City of New York.

The first session, Thursday, Oct. 20, 10 a. m., to 12, and 2 to 4 p. m., will be devoted to Administrative Problems of Finance, Regulation of the Disturbance of Pavements, Regulation of Loads; Regulation of Traffic; The Obligation of Railways, Buses, Commercial Vehicles and all other users of the street; Records, Traffic Data, Future Growth and Usage; Inspection of Repairs; Inspection of New Work; The Desirability of Guarantees.

8 p. m. to 10 p. m.—Repairs and Maintenance Problems: Agents which destroy pavements; Methods of repair and restoration; Resurfacing and reconstruction of old pavements; Maintaining boxes, manhole heads, street railway tracks, etc., in connection with the pavement.

Oct. 21st, 10 a. m. to 12 noon—New Pavements: Factors upon which the necessity for new pavement are determined; The types of city paements; Fators determining the type of pavement to be used. 2 p. m. to 4 p. m.—Foundations: Sub-base, kind, character, utilization of the existing base; Preparatory steps to laying of the new pavement, such as examination of existing surface and sub-surface structures for leaks, replacements, extensions and additions; The economical depth of new foundations; The proper construction for street railway tracks to permit of efficient paving between the rails, between the tracks and adjoining the outside rail.

Evening—Subscription Dinner and Social Meeting.

There will be two principal speakers for each session. Their papers will be prepared, printed and distributed as far in advance of the meeting as possible. Synopses of these papers will be read, occupying not more than 15 to 20 minutes each. Verbal discussion will be limited to 5 or 10 minutes per speaker; longer discussions to be written and read by extracts. The complete record of the sessions, including papers and disussions, both verbal and written, will be published in the Journal of the Engineers' Club of Philadelphia.

INDUSTRIAL RELATIONS ASSOCIATION OF AMERICA

The annual convention of the Industrial Relations Association of America will be held at the Waldorf Astoria Hotel, New York, November 1 to 4. The association is the outgrowth of the National Association of Employment Managers formed in Rochester in 1918.

The Industrial Relations Association will hold a joint session on November 4 with the Academy of Political Science in connection with its discussion of industrial relations. The association's sessions will be inaugurated by a banquet at the Waldorf on the night of November 1. E. A. Shay, 671 Broad street, Newark, N. J., is the acting executive secretary of the Industrial Relations Association.

OHIO STATE ASSOCIATION OF BUILDERS EXCHANGES

The midsummer conference of the Ohio State Association of Builders' Exchanges was held at Cedar Point, Ohio, July 22. The meeting was presided over by President James J. Dalzell, of Youngstown, and delegates were present from a number of Ohio cities and from Pittsburgh, Pa. At this meeting reports were read by officers and delegates, perhaps the most important of which was the report of the secretary on the conferences held in conjunction with other state associations relative to the subject of "Taxation." Several resolutions of interest were adopted, including one approving of the American Building Exposition in Cleveland the coming winter, one to investigate freight rates on building materials, and one investigating the workmen's compensation insurance rates for the purpose of lowering said rates.

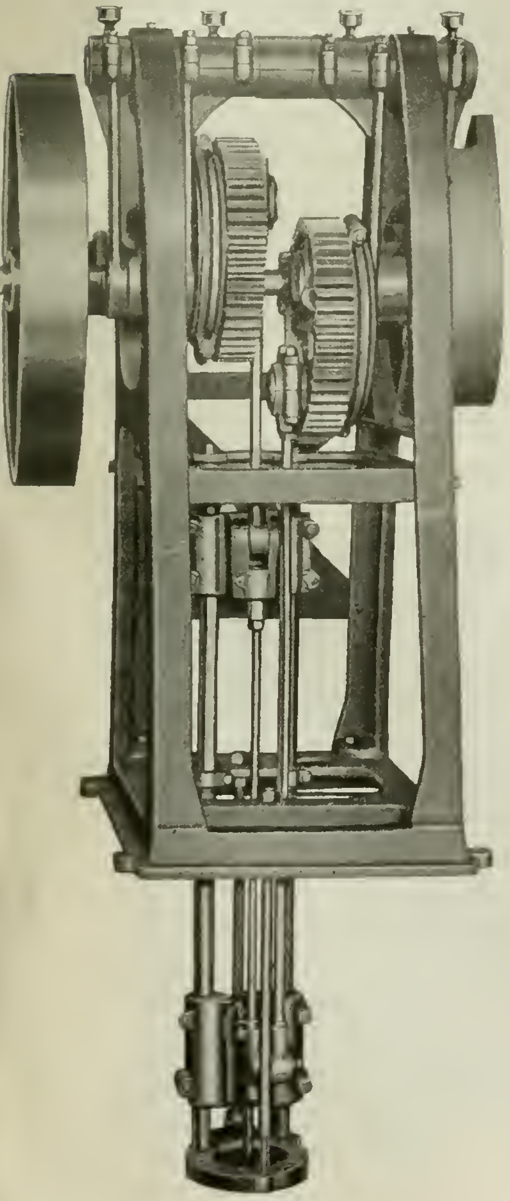
New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

CHIPPEWA PUMPS

The steady stream, deepwell pumps manufactured by the Chippewa Pump Co., are of a continuous flow plunger power type intended to meet every possible pumping condition for either light or heavy duty and to withstand continuous and severe usage. In this pump the even rotating motion of the power shaft is converted into a reciprocating motion, applied to the pump piston that moves alternately upward at even intervals and downward by quick return strokes, so that while one is under the load the other is rapidly returning without load, stops and starts slowly upward before the first has completed its upward movement.

The principal element of the pump includes a power shaft journaled in fixed bearings and having mounted on it pinions driving large crank gears journaled on eccentric pivotal connections. The eccentric link encircles the hub of the crank gear and holds its teeth in mesh with driving pinions.



STEADY STREAM DEEP WELL PUMP

The connections of the pitman hanger to the crank gear are diametrically opposite each other so that a reciprocating motion is imparted to the plunger rods when the pitman describes an elliptical path with the long axis vertical in line with the reciprocating parts. The ellipse is irregular, one side being shorter than the other to provide a quicker downward thrust to the pump rod and the longer upstroke.

When two or more gear units are used, the strokes are made to overlap. The successive operation of the two plungers, whereby one picks up the flow before the other drops it, makes the water column move constantly and uniformly, and avoids a great loss of strain and wear of parts in overcoming interrupted motion of the water column.

All Chippewa Pumps are very simple in action and are capable of taking water from wells and delivering it directly to stand pipes or to the mains, thus eliminating water hammer and vibrations.

Different types of Chippewa Pumps are designed to meet the requirements of suburban residences, small municipalities, and for heavy duty and large capacity and deep well service required for municipalities, pumping stations, irrigation projects and for other purposes. The catalog lists pumps with capacities rated from 5.8 gallons per minute at a maximum head of 200 feet to a capacity of 135 gallons for a maximum head of 830 feet or of 800 gallons for a head of 215 feet.

The principal advantages claimed by this pump include constant moving water columns, ability to discharge directly to the mains and fire hose, non-fluctuating loads on pump mechanism and on prime mover, elimination of dead load, minimum power with maximum efficiency, low maintenance cost, accessibility, continuous even suction, silent operation, and entire absence of water hammer besides several other valuable features.

NORTHERN ROTARY PUMPS

The Northern rotary pump, manufactured by the Northern Fire Apparatus Co., will deliver from 10 per cent to 30 per cent more water per horsepower than any other pump manufactured.

It will hold a 29-inch vacuum. It will deliver 50 per cent more or 50 per cent less than its rated capacity without varying more than 5 per cent in efficiency. It has a pressure range from 50 pounds to 500 pounds.

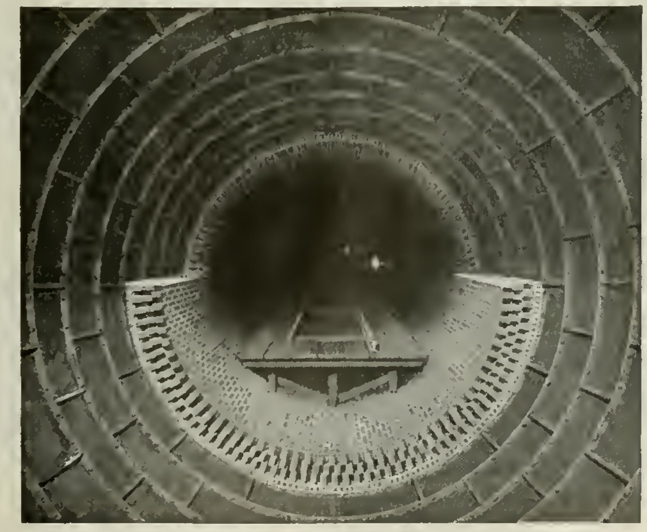
It can be equipped with a positive acting Sure Relief valve, which will automatically by-pass the water at any desired pressure.

It is small, compact, rugged and practically non-wearoutable.

TRUSCON TUNNEL LINER PLATES

The steel tunnel liner plates manufactured by the Truscon Steel Co., are flanged sections of light pressed steel plates that, bolted together, make a continuous rigid shell carried forward in the excavation to support the roof and sides a considerable distance in advance of the masonry.

They promote safety, convenience and economy and expedite the work which can be carried on either with bricks or concrete. The same company manufactures a large variety of steel forms, including those that can be used in connection with the liner plates for the inner surface of the tunnel.

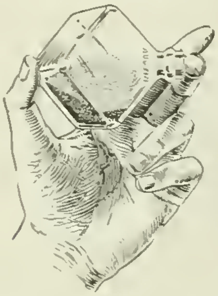


TUNNEL EXCAVATION LINED WITH STEEL PLATES AND BRICK INVERT LAID ON THEM

AUSTIN CUBE MIXER

The Austin Machinery Corp., Chicago, Ill., is distributing an attractive model intended to demonstrate graphically the mixing action taking place in the Austin Cube Mixer, when in operation.

A hollow glass cube, 2 inches square, has a corked opening on one corner and a concave depression in the exterior surface at the opposite corner. It contains a small amount of red sand and a black bean, and is accompanied by a little bag of white sand.



When the contents of the bag are emptied into the cube and the latter is recorked and revolved between thumb and forefinger applied to the cork and the opposite concavity, the observer can easily watch the mixing action and see the rapid combination of the red and white sand. He can also note the kneading action indicated by the fact that the black bean is alternately covered and exposed, coming to the surface three times in every complete revolution of the cube, which turns it over six times and changes the shape of the mass twelve times for every revolution.

The operation illustrates the same conditions in the full size machine where the mixing action is continuous and the full batch is thrown toward the discharge side three times with every one of the 54 to 144 revolutions made per minute.

FOX ROTARY SNOW BROOM

The Fox Rotary Snow Broom is an attachment that can, in a short time, be attached to the F. W. D. trucks that, on other occasions are used in many states for dumping and other purposes and thus can be available for snow removal without requiring the entire apparatus to be constantly held in storage for emergency.

The broom embodies the design and improvements developed by years of experimenting and snow removing by practical men, combined with engineering advice that has produced a broom giving results claimed to be even in excess of the anticipations of the designer when demonstrated in the heavy snowstorms of February, 1921.

It is of sturdy rigid construction, easily attached to the truck chassis, and is equipped with a 50-h.p. Wisconsin motor with speed silent chain drives to the double broom.

The broom is counter balanced so as to automatically rise when it encounters obstructions, and is provided with a sheet steel shield to prevent the snow from being thrown on the sidewalks. The broom, 34 inches in diameter, will clear a road space 9 feet wide. It is made in halves clamped to the shaft and will give at least 48 hours' constant service.

In a letter from County Engineer Garwood Ferguson, the writer stated that he had witnessed demonstrations of the Fox Rotary Snow Broom and believes that this is the best type of broom for cleaning snow from highways that he had ever seen, and that for snowfalls from 8 to 12 inches deep there should be no difficulty in cleaning from 50 to 75 miles a day.

PERSONALS

Finch, Jeremiah C., has been made secretary of the New York State Highway Commission, Albany, N. Y.

Hutson, W. F., is now district engineer of the Texas State Highway Department at Waco.

Ross, F. E., has been appointed city engineer of Jefferson City, Mo.

Kendrick, William, has been appointed director of the new advisory board of highway research of the National Research Council.

McDonald, S. P., has been appointed to membership on the Alabama State Highway Commission.

Cate, D. R., is now assistant engineer to the city engineer of Sacramento, Cal.

Tempest, J. E., is now deputy city engineer in charge of street work of Sacramento, Cal.

Lyons, Edward L., has been appointed engineer of the division of the Bureau of Surveys of Philadelphia.

Barber, William C., has resigned as city manager of Dayton, Ohio.

Cornelius, Charles E., has taken over his father's business at 2139 Fulton avenue, Cincinnati, Ohio.

Froseth, O., is now in the office of the chief engineer of the Illinois Central Railroad, Chicago, Ill.

Green, George G., has been appointed municipal engineer of the Canal Zone.

Horridge, John, has been appointed supervising engineer in the division of street cleaning, department of public works, Philadelphia, Pa.

Fallon, Bernard J., has been appointed general manager of the Chicago elevated railway system.

Smith, Herschel C., has been appointed professor of highway engineering and highway transport at the University of Michigan.

Hinkley, W. O., is now engineer with the Stanley Consolidated Mines of Idaho Springs, Colo., engaged in underground surveying and the design of small structures.

Summa, Victor M., has opened an office in St. Louis, Mo., for the practice of general consulting engineering.

Ward, Robert L. E., has been made manager of the office of Weiland Engineering Co., in Canon City, Colo.

Trowbridge, Frederick J., has opened an office in Waterbury, Conn., and will practice civil engineering and surveying.

Morrison, Arthur H., is now with the Moulton Engineering Corporation, Boston, Mass.

Baldwin, E. W., will become an active member of the Mid-West Engineering Co., Coffeyville, Kans.

Andrews, John S., of the Ferro Concrete Co., Seattle, Wash., died July 17.

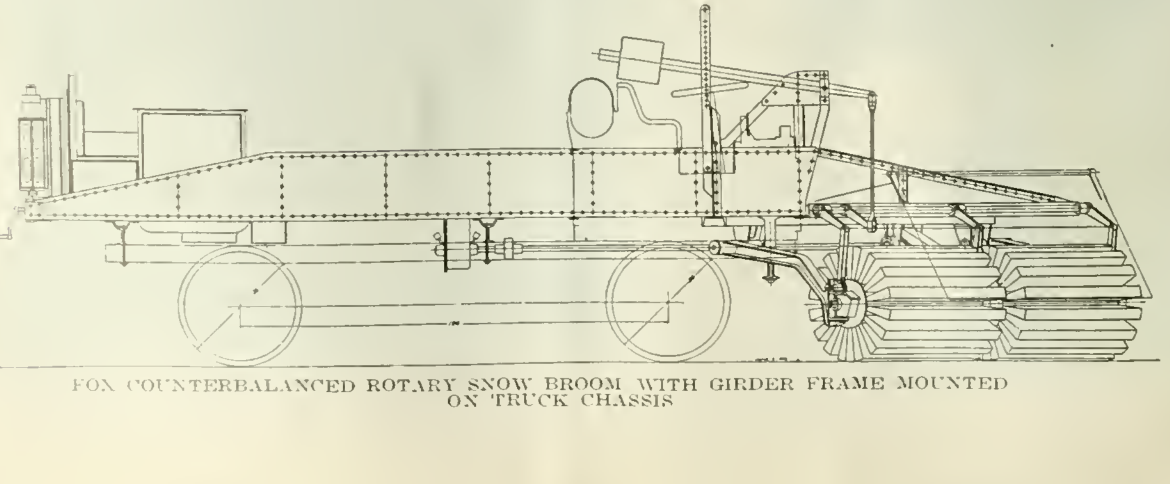
Strobridge, J. H., died July 27 in Hayward, Cal. He was constructing engineer for the Pacific and Southern Pacific Railroads.

Wilt, Josiah, died at Bethlehem, Pa., on July 24.

Gunn, William died in Winnipeg, Can., on July 24 after a long illness.

GEORGE H. TEFFT

George H. Tefft, Secretary of the Clay Products Association, Chicago, died in Philadelphia, July 7, and was buried at his old home in Springfield, Mo., July 11. Mr. Tefft, who has long been very prominent in the Clay Products interests and activities had been for some time in poor health, but nevertheless attended the annual meeting of the American Society for Testing Materials, at Asbury Park, N. J., last June, where his condition became much worse, indications of sleeping sickness were observed, and he was removed to Philadelphia where he died.



FOX COUNTERBALANCED ROTARY SNOW BROOM WITH GIRDER FRAME MOUNTED ON TRUCK CHASSIS

PUBLIC WORKS.

CITY COUNTY STATE

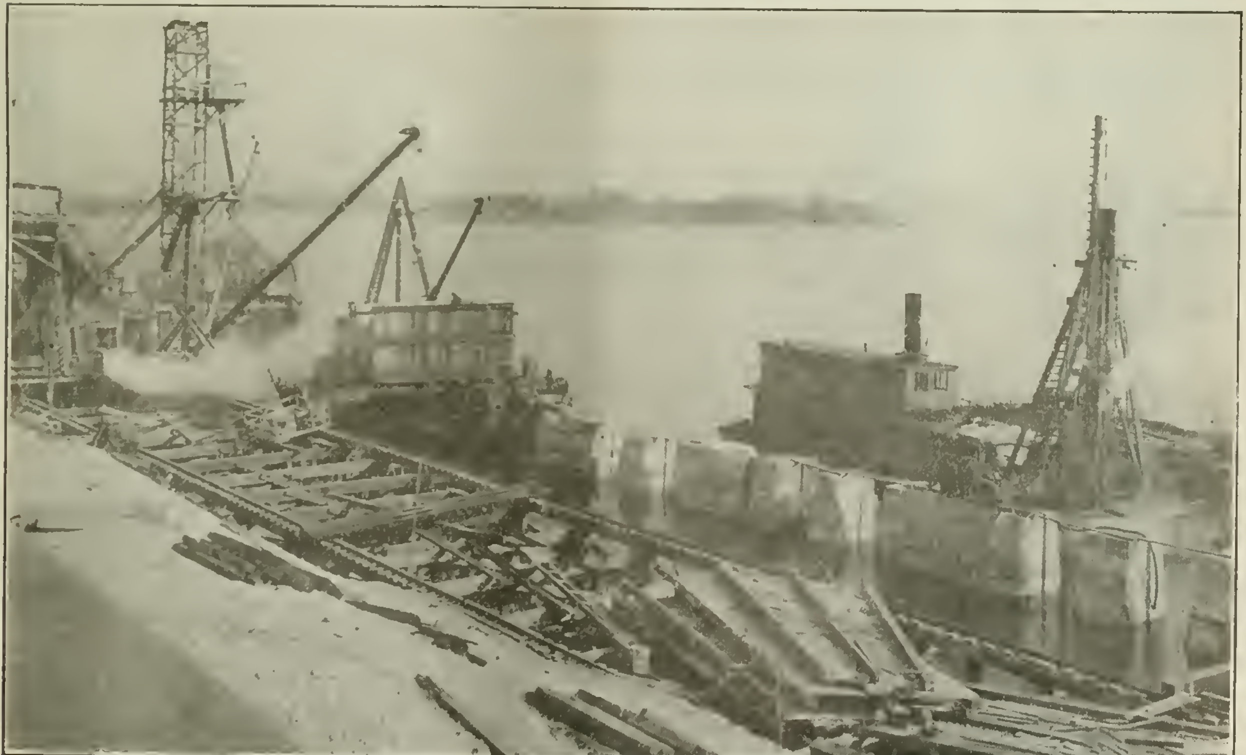
A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 SEPTEMBER 17, 1921 No. 12

Hell Gate Power House Tunnel and Wharf

Rectangular concrete discharge tunnel wall and river piers of wharf concreted under water on rock bottom. Tunnel floor, roof and core wall concreted in cofferdam formed by river wall. Extensive special plant installed for excavating submerged rock and for concreting under water.

Construction is well advanced on the 280,000 K. W. steam power plant of the United Electric Light & Power Co. on the west bank of the East river, between 132d and 134th streets, New York City, from which it is expected to deliver current during the early winter. The principal structures include a steel and masonry building 370 feet long, parallel to the river, that is 250 feet wide and 120 feet high and contains the turbine and boiler installation and the initial generating equipment, of which only one half the ultimate installation will be placed at present. Adjacent to the boiler room is the 105 x 212-foot 7-story electrical gallery building and between the main building and the river is the wharf about 480 feet long that is trapezoidal in plan with a width varying from about 24 to 70 feet. The massive concrete tunnel wall serves also as foundation for the river wall of the main building and to carry the shore side of the wharf, the river side of which



TRAVELER TRACK AND SECTIONS OF SEA WALL. WALL FORM PANELS IN FOREGROUND is carried on 12 long and narrow piers transverse to the shore line and about 47 feet in extreme height. The paved concrete floor of the wharf is carried on steel beams and girders enclosed in concrete and resting on the piers and tunnel walls.

The condensing water discharge tunnel runs underneath the operating room for its full length and is parallel to the front wall of the building except at the upper end where it is placed at right angles and continues from the shore line to the bulkhead line and forms the outer edge of the wharf, and at the lower end where it makes an oblique angle from shoreline to bulkhead line. The regular cross section is 11 feet 6 inches wide and 15 feet 6 inches high inside dimensions, with the floor 10 feet below mean low water level. The floor slab, concreted on the rock bottom, is of varying thickness up to about 7 feet maximum. The river wall is 16 feet thick.

In the river wall, which is virtually a sea wall, there are imbedded 16 straight cast iron intake pipes 27 feet long, making an angle of about 49 degrees with the horizontal and having their lower ends clear of the base of the sea wall and cut off in a horizontal plane 12 feet below low water level. The corresponding vertical discharge pipes, 42 inches in diameter, are imbedded completely in concrete and the lower ends make right angle long radius bends, bringing the ends of the pipe into the vertical face of the tunnel wall. The tunnel may be oponed at both ends so that the discharge tunnel is substantially a covered canal with the upper part just below high tide level. The openings between the transverse piers that support the wharf beyond the wall are closed by vertical screens parallel to the sea wall engaging recesses in the piers and thus making a large covered intake open to the river and providing unlimited condensing water supply instead of restricting it to the capacity of a tunnel.

DREDGING

Over the entire area covered by the wharf and tunnel the bottom consisted of a Manhattan schist stratification, some of it nearly vertical, covered with from one to three feet of soft and hard mud, and water having a maximum depth of 14 feet at low tide, and about 20 feet at high tide, with maximum current of about 5 miles per hour. The upper part of the rock was so soft and decomposed that excavation to sound rock was necessary over the entire area and involved the removal of about 25,000 yards of submerged rock. Under the tunnel and an adjacent part of the wharf the rock was removed to an approximate depth of about 14 feet below low tide, descending by an almost vertical drop to a lower level where it had an approximately horizontal surface more than 35 feet below low tide.

CAISSONS

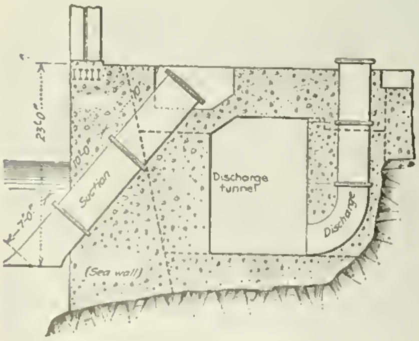
The sub-contract for dredging was awarded to P. Sanford Ross, Inc., who installed on the work two dipper dredges with buckets of 6 yards and 3½ yards capacity, respectively. These handled the soft material and the rock after it was broken by blasting and by the rock breaking machine, which had a 16 x 16-inch solid steel chisel about 35 feet long installed on a scow and operated up and down with a churning motion that was very efficient in soft and decomposed rock where it penetrated several feet.

Harder rock was drilled with 3-inch holes sunk at the average rate of about 30 feet per day by a single drill mounted on each of two drill boats. The holes were loaded in the usual way with dynamite cartridges inserted through casings and after the charges were fired the broken rock was removed by the dipper dredges that delivered it to attendant dumping scows that were towed out to sea where the rock was disposed of. No pains were taken to secure a uniform or strictly level surface and irregularities were preferred in order to make better bonding with the concrete.

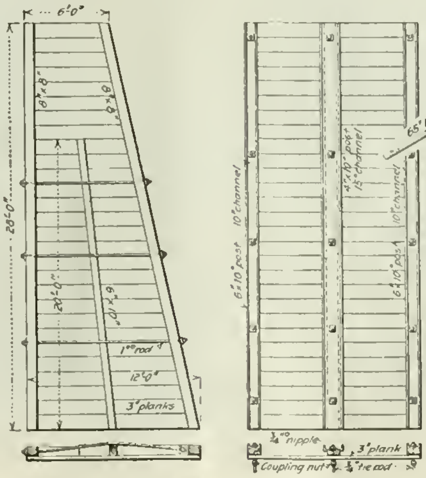
SECTIONAL CONSTRUCTION OF SEA WALL

The sea wall 480 feet long, 6 feet wide on top and 12 feet wide at the bottom has an extreme height of about 28 feet, reaching to an elevation of about 18 feet below mean low water, and was built in sections about 21 feet long, the alternate sections being first concreted in complete forms after which the intermediate sections were concreted between them and joined them together to make a continuous wall.

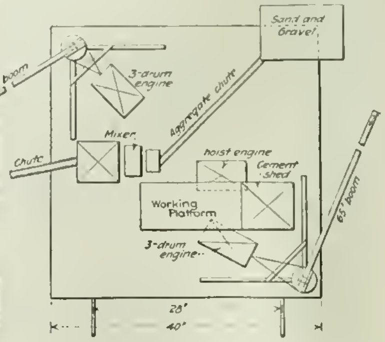
The forms 12 feet 9 inches long inside, were built complete on shore and swung to position by



TUNNEL AND SEA WALL



WOODEN FORM FOR SECTION OF SEA WALL



PLAN OF TRAVELER WITH CONCRETE TOWER

the derrick traveler. Each form was made with four wooden panels having 3-inch horizontal planks spiked to 6 x 10-inch vertical and inclined outside posts, one at each corner, which were reinforced with 10-inch channels bolted to their outer faces to give added stiffness and decrease bouyancy so that they would sink by their own weight when immersed. The ends of the forms were reinforced by an intermediate outside 6 x 10-inch vertical timber 12 feet long in the center of the panel, and by three horizontal tie rods located 6 feet, 12 feet, and 17 feet from the lower edge, which passed through the corner posts and were slightly bent to take bearing against the outer surface of the intermediate stiffening piece and thus developed a truss action. The vertical panel for the outer face and the inclined panel for the inner face of the wall were stiffened on the center line with a 4 x 10-inch vertical plank and a 15-inch channel which were bolted together with five 1-inch horizontal tie rods, passing through the form. The tie rods were cut a little short of the width of the form and at each end were connected by a coupling nut to a ¾-inch nipple, 10 or 12 inches long, that projected through the planking and the channel and engaged nuts and washers on the outer end. When the forms were stripped the nipples were unscrewed from the coupling nuts, permitting the tie rods to remain permanently engaged in the concrete.

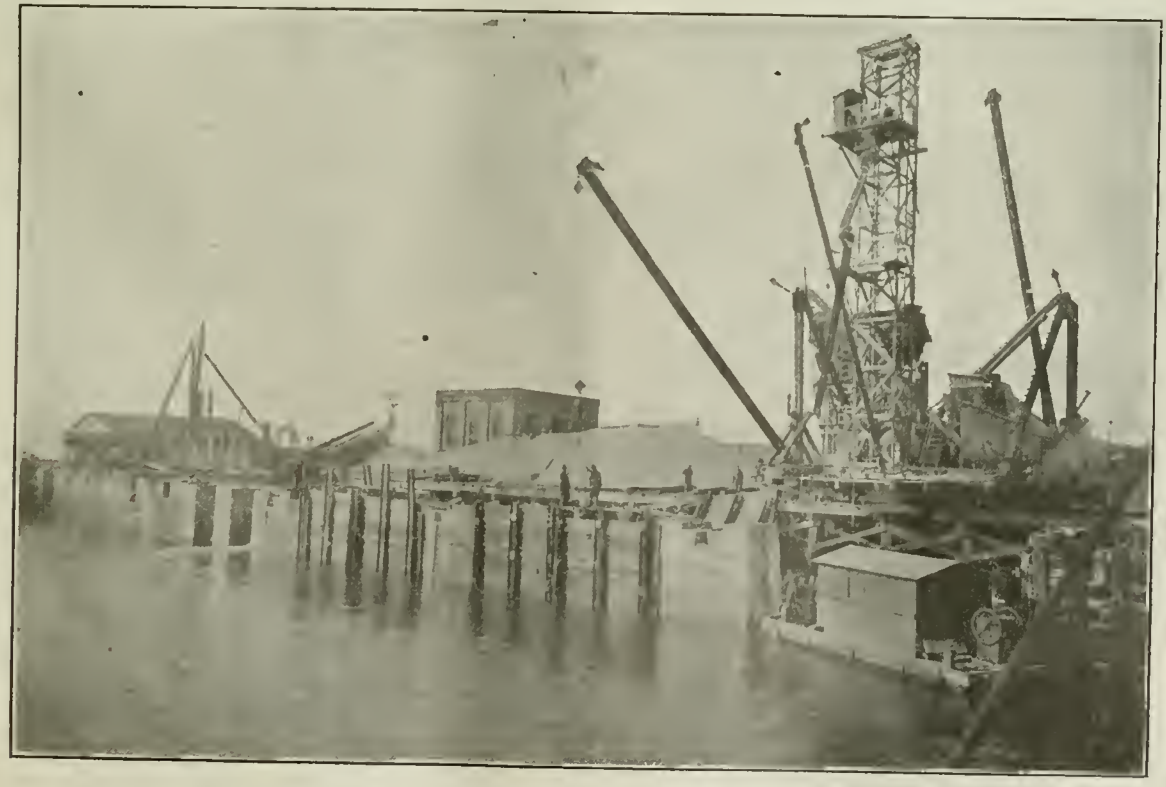
The forms, weighing in air about 12 tons each, were placed in position where they rested on the irregular rocky bottom. They were inspected by divers, who cleared loose materials away from the bearing if necessary and nailed short vertical planks on the outer sides of the forms to provide sheeting reaching down to the surface of the rock and held in position by sand bags carefully piled around them to close the larger openings and give additional stability.

DIPPER DREDGE DELIVERING EXCAVATED ROCK TO SCOW

The divers then entered the forms and cleared the surface of the rock with a water jet and by loading fragments of rock into buckets operated by the derricks, and removed mud, etc., by the suction of an 8-inch centrifugal pump.

After the alternate sections of the sea wall were concreted the forms were unbolted by divers and the closure sections of the wall were concreted.

(To Be Continued)



FRONT OF SEA WALL. ALTERNATE SECTIONS CONNECTED BY FORM PANELS. DERRICK TRAVELER WITH CONCRETE PLANT AND HOISTING TOWER

Concreting the Gansvoort-Schuylerville Road

Contractor quarries and crushes stone and stores more than 5,000 yards ready for beginning of season. Stone delivered over industrial track to aggregate bins and thence trucked to mixer. Total force of 130 men do heavy grading and average 300 feet of 16-foot concrete pavement per day.

There is under construction in northern New York state, along and near the west bank of the Hudson, from Gansvoort to Schuylerville, and in the village of Schuylerville. a concrete road totaling 9.63 miles in length which contains some unusual features of design and interesting details of construction method.

The greater part of this, 9.02 miles in length, is being built by MacArthur Brothers Company, of New York, and extends just to the village boundary. It is 16 feet wide on tangents, with additional width on curves, and is being built for the state. It is continued inside the village by a pavement 24 feet wide, of which 16 feet is paid for by the state and the remainder by the village. This totals 0.61 mile, in two sections, and is being built by F. F. Baker. of Mechanicsville, as contractor.

THE MACARTHUR CONTRACT

The larger contract was awarded in November, 1919, for a total of about $331,000. Some rough grading was done the following winter, there being considerable cutting and filling, one cut about 15 feet deep. In the spring of 1920 the work was organized and concreting was begun in June.

The contractor opened a quarry about a half a mile east of the road under construction (which runs approximately north and south), and about two miles south of the northern end. About 500 feet from the quarry two jaw crushers were established, fed by rock brought from the quarry by industrial cars. The crushers discharged directly by gravity into other industrial cars, or into a stock pile when cars were not being loaded. By the end of last season there had been accumulated a surplus of about 5,200 cubic yards of stone which was used in this spring's construction.

In going from the crusher, the train passed sand bins, where sand was received, and a little farther on the cement was added as the train passed the cement shed. Each car carried two buckets, each of which received a measured amount of stone and sand sufficient for one 4-bag batch. On reaching the mixer, the buckets were lifted from the cars by a crane attached to the mixer and dumped into the charging skip.

TRANSPORTATION

The industrial track was laid to the road and along the side of the road to the north end of the line, at which pavement laying was begun. Laying was continued south of where the branch to the crusher left the road until 22,100 feet had been laid. This was thought to be the limit of economical use of the industrial railway, and bins for stone and sand were built here and the industrial track taken up and laid south from this point—station 255. The aggregate was brought to the bins by trucks running over the new pavement. At the bins the tracks ran up onto a bank alongside the road so high that the trucks dumped directly into the bins. The trucks were furnished with bodies having an A bottom and side doors for side dumping. This method of operating was continued to station 100, when the use of industrial track was discontinued.

There is either cutting or filling over a large percentage of the length of the road, and this made it difficult to lay track alongside the road, and impracticable to locate switches less than 1,000 feet apart. This made continuous operation of the mixer impossible, and it was estimated that a third of its time was lost because of this.

Moreover, the grades were heavy, some of those of the original road running above 12 per cent (although 7 per cent was the maximum grade of industrial track) and the finished road having one grade as high as 9 per cent for a continuous stretch of a thousand feet. This cut down the number of cars the dinkie engines could haul to six or occasionally seven, although the same engines had hauled ten-car trains on Pennsylvania road work done by these contractors. Three dinkies were used and about 30 cars were on hand.

Station 100 was selected as the point for discontinuing the industrial track because the laying of the pavement toward the south had to be stopped here, the road south of this point sloping down on a 9 per cent grade, which was too steep to economically operate the industrial haulage system.

The laying plant and gang were accordingly transferred to the southern end of the contract and started north, and about a thousand feet of this had been laid at the time the writer visited the work. The stone is now brought by rail and is hauled to the work from a siding a short distance away by trucks. Sand also is hauled by trucks, from banks along the road where it is dug by the contractor. The aggregate is dumped on the right of way and loaded into the charging skip by wheelbarrows. The cement used is made in Glens Falls, about twenty miles away, and is brought to the work directly by truck.

CONSTRUCTION OPERATIONS

A Lakewood finisher had been used on most of the work; but most of that done recently has been on curves, where the extra width (as much as six feet in some cases) made a pavement too wide for the finisher; and moreover on the curves the surface had a straight cross-section instead of crowned as on tangents. On the curves, therefore, hand finishing was employed, using a tamping template and belt, followed by drawing a rattan broom across the pavement to roughen it.

The concrete is being mixed by a "Milwaukee" 4-bag mixer, which turns out a batch in an average of 3 minutes, more than one minute of which is due to the bucket on the broom holding only half a batch and having to make two trips. Moving the mixer at intervals requires about two minutes. Water is furnished through a two-inch pipe by a "Domestic" gasoline pump drawing water from a pond.

The force consists of about 14 men on the wheelbarrows, an operator and a fireman on the mixer, 2 spreading, 2 tamping, 2 finishing, 1 cement man, and 5 to 8 others collecting cement bags, setting forms, grading, water boy and handy men, a total of about 31. This gang is averaging about 300 feet a day.

In addition, there are grading gangs, at which work about 80 men are just about kept ahead of the concreting gang. Three Fordson and two International tractors are used for hauling plows, Maney wheel scrapers and for other purposes. There is considerable shale rock along the route, which cannot be broken up readily by blasting but is very hard for picking. The total number of men employed on the contract runs about 130. Common labor is paid 30 to 40 cents per hour and works ten hours a day. Ten trucks are used, hired from local owners. The subgrade is rolled with a Charles Loudenecker road roller.

The road is given 7-foot shoulders made of soil only, on each side. In cuts, longitudinal drains are laid outside the shoulders, 6-inch porous tile being used in trenches 2 feet deep and filled with broken stone. From these side-drains 6-inch diagonal drains at 50-foot intervals run in alternately from the opposite sides.

Expansion joints are placed at intervals of 35 feet, solid expansion material being used. Reinforcement is placed at mid-depth, weighing 0.25 pound per square foot of pavement.

One day after completion, the pavement is covered with two inches of dirt thrown on from the sides and kept wet for ten days.

Guy Ripley is manager of the job for the contractors and Thomas Farrell is superintendent. D. P. Rookan is engineer in charge for the state.

THE BAKER CONTRACT

Owing to the width of the pavement in the village—24 feet, with a 4-foot shoulder on each side—it was thought impracticable to finish this in one strip, and it is being made in two 12-foot strips. A new feature is the longitudinal joint which is made with longitudinal corrugations, by placing against the middle form strips of corrugated 28-gauge steel 6 inches wide.

The reinforcement is heavier than on the other contract, being 0.3 pound per square foot. In addition, there is placed at each expansion joint (which joints are placed 60 feet apart) a steel rod ½-inch diameter set 6 inches back from the joint in each direction, the rod having each end turned back so as to lie 6 inches in from the side of the slab for a length of four feet. These rods weigh 0.85 pound per lineal foot.

The concrete is made of 6-inch uniform thickness with a 3-inch parabolic crown. It is finished off with a tamping template with plow handles on each end; rolled, and finally roughened with a broom.

This contractor uses a Jaeger 2-bag mixer which he has mounted on a light, low truck and provided with a chute. With this he averages 230 feet of 12-foot pavement a day, varying from 200 to 250. The gang includes 10 wheeling aggregate, 1 operator, 1 cement man, 3 men placing concrete, 2 finishers, a handy man, and a foreman.

Before concreting, an average of nearly a foot of old macadam was removed, about 2,700 cubic yards in all having been removed from the 0.61 mile. The subgrade is left undisturbed, the concrete being laid directly on the old macadam left in. Included in the contract was some 16-inch storm sewer with drop inlets at street corners.

F. Ray Williams is engineer in charge of this contract for the state.

Pennsylvania Highways Depend Upon Constitutional Amendment

At the coming primaries in Pennsylvania the voters are to adopt or defeat proposal for a constitutional convention, the purpose of which is to adopt a section authorizing the state to incur an indebtedness up to $150,000,000 for highways and up to $25,000,000 for forest purposes; no debt for highway purposes to be created, however, without the consent of two-thirds of each house of the general assembly and that of a majority of the electors of the commonwealth voting on the question.

The last of the $50,000,000 bond issue authorized in 1918 will be expended by the end of 1922, and from that time on the department will be dependent upon legislative appropriations, which are becoming more difficult to get with each succeeding session. A constitutional amendment was passed by the 1921 assembly for an additional $15,000,000 for highway construction, but unless a constitutional convention is held it will be necessary that this amendment be passed again by the 1923 assembly and then ratified by the electors in 1924, thus postponing until 1925 the availability of any money so provided for. With the proposed change in the constitution, an additional $50,000,000 bond issue could be made available by one vote of the assembly and ratification of the people, which would make the money available in 1923 or 1924, thus reducing to one or two years the lapse in intensive construction which would otherwise extend over three years.

Highway Commissioner Sadler states that it will require approximately 1,000 miles of highway or $50,000,000 of money, after the expenditure of the present available funds, to complete the primary road system of the state.

Yarhola Pipe Line

Installation of 558 miles of 6 and 10-inch screwed pipe with river crossing and telephone systems. Ditching 60 per cent executed by machines. Mississippi river crossing 3,000 feet long laid by derrick boat. Pipe bent to profile and joints screwed by traveling machines. Pipe tested by 850 pounds pressure.

The Yarhola pipe line, Sanderson & Porter, New York, engineers and contractors, was designed and built for the Roxana Petroleum Co. for the transportation of oil from Healdton oil field in south central Oklahoma 130 miles to a refinery at Cushing, Oklahoma and thence about 428 miles to the Wood River refinery at St. Louis.

It comprises a total of about 130 miles of 6 inch and 428 miles of 10 inch earth, covered steel pipe with screw joints laid to the natural profile of the straight line route and the St. Louis division is equipped with five intermediate stations, each with pumping installations and having a capacity for a daily delivery of 24,000 barrels of oil against a pressure head of 800 pounds.

The 6-inch line from the Healdton oil field to Cushing has a daily capacity of 12,000 barrels, and its construction was commenced in May, 1916. The general features and construction methods adopted for building it corresponded essentially to those of the 10-inch line 428 miles long from Cushing to St. Louis, the construction of which is here described.

The building of the line involved the hauling of 69,000 tons of material an average distance of 8.85 miles and a maximum distance of 21 miles. Besides the laying of the pipe line the contract included the construction of the pumping stations and the installation of their mechanical equipment with Diesel oil engines of 6,000 h.p. total capacity that were made in America. That the work was rapidly and successfully completed under adverse conditions reflects credit on the ability and resources of the engineers and contractors and of the manufacturers, The Allis-Chalmers Mfg. Co., who supplied the engines and the 12,000 barrel pumps; the National Transit Pump & Machine Co. who supplied the 8,000-barrel pumps; the Youngstown Sheet & Tube Co. who supplied the line pipes; the Crane Co. who supplied the steel valves and fittings and Henry J. Brandt, of San Francisco, who did the hauling.

ACQUIRING RIGHT OF WAY

Although condemnation proceedings are provided for by the laws of Oklahoma, they were not resorted to in this case, and the right of way, 20 ft. wide for the full length of the line, was acquired wholly by easements purchased from the property holders. A paper location of the line from terminal to terminal was made on strip maps compiled from existing government maps, surveys and other sources and showing roads, railroads, government sections, sub-divisions and some other data. These indicated the most convenient unloading points and highways for delivering and hauling materials and showed river crossings and principal elements of topography, verified and extended by a reconnaissance made in advance of the survey.

The survey was run providing stations and field notes with special reference to highways and to locations of corners of government subdivisions and permanent reference marks, all of which were carefully platted on the strip map with the final location of the lines.

The entire strip map was divided into short sections, and plats of each, showing the location and sub-divisions, were furnished to the right-of-way men who were specially selected for their skill, ability and experience in this work. They commenced operations by investigations in the recorder's offices where they made pencil abstracts of all desirable data regarding the land crossed, additional sub-divisions from sales and transfers, and secured the names of all the owners and the facts concerning mortgages, leases and other interests involved in the property.

Provided with these data, the twelve experts were engaged for a year in procuring the 2,000 necessary easements and about 6,000 other documents required to establish the right of way at a cost about equal to the sum actually devoted to the purchase of the easements from the property holders. All of this work was completed in advance of field construction and provided merely for the right of installation and of ingress and egress for maintenance, without including any property rights.

TELEPHONE AND CLEARING GANGS

In order that all construction parties should at all times be in communication with the head office, a telephone line was installed in advance of all other field construction. In general this line was established on the right of way, but in some cases where this was impracticable it was necessary to make detours so that the total length of the telephone line was approximately 650 miles, from the oil field to St. Louis.

Northern cedar poles 20 ft. long were delivered and placed 150 ft. apart on the right of way by the contractor who hauled the pipes. The poles, with brackets and insulators attached, were raised by hand by two pole gangs of about ten men each, that dug holes 3 feet deep and just large enough to receive the butts of the poles which were from 12 to 16 inches in diameter.

In earth, the holes were made in the ordinary way with crowbars and spoon shovels but where blasting was required, holes were drilled with jack-hammers operated with air from portable Chicago Pneumatic Tool Company's gasoline driven compressors, two of which were provided for the work. Blasting was done with 60 per cent. dynamite.

The pole gang also did the small amount of grading necessary for trimming the very steep sides of ravines and providing practical ingress and egress to highways. No other grading was required because the pipe was laid parallel with the surface of the ground, as elevations or depressions do not influence the pumping of the oil through the finished line.

The pole men were followed by ten-men gangs of wire stringers who under favorable circumstances advanced 3 miles per day, installing the wire, and guying and anchoring the angle poles.

The telephone crews were followed by the four clearing crews, each having a party of six to twelve men equipped with axes that cut the timber, burned the refuse, and removed the stumps by blasting with 40 per cent dynamite wherever this work was done by the contractor. Preferably arrangements were made with the owners or occupants of the land to clear the right of way, generally accepting the timber on it for payment or part payment of their services.

DELIVERY OF PIPE

The 427.79 miles of 10-inch pipe, plus the machinery and materials for the stations had a total weight of approximately 70,000 tons, which was delivered from the railroad to destination, an average haul of about 9 miles over dirt roads that were generally poorly graded and surfaced. The longest haul was 21 miles, the pipes being transported on pairs of wagons drawn by eight or more mules or horses pulling an average load of 1,500 pounds per animal.

The sizes of the loads were decreased and the difficulties increased by the fact that most of the streams too large for culverts were without bridges and had to be forded, and the existing culverts were in such poor condition that they very generally required repairs by the hauling contractor H. J. Brandt, San Francisco. Care was taken to deliver all pipe lengths, with their couplings attached to the east ends and to distribute them accurately, end to end on the right of way close to the alignment so that they required no longitudinal transfer and the minimum transverse movements for installation.

DITCHING

The pipe was laid in a ditch about 28 inches deep and 24 inches wide, about 25 per cent of which was located in rock that was drilled and blasted. The remainder was chiefly through cultivated and pasture land where about 15 per cent of the total amount was in hilly or rocky localities and the ditch was dug by hand. The remainder, amounting to about 60 per cent of the entire line, was excavated by two self-propelling Buckeye ditchers of the caterpillar type and equipped with electric headlights for night work.

These machines were provided with extra wide digging wheels of comparatively small diameter; operated by three men they were each capable of digging about 2 miles of trench per day under favorable conditions.

All of the spoil was deposited alongside the trench and after the pipe was laid, backfilling was accomplished by teams and special scrapers depositing the material in the trench without tamping or compressing.

SUBMERGED TELEPHONE LINE

A telephone line was carried across the Mississippi River in an armored cable 3,000 feet long, weighing 13,400 pounds and supplied by the Western Electric Co. The cable was wound on a large reel mounted on the deck of a barge that was towed across the river allowing the cable to unwind and sink to the bottom as it advanced. At intervals of about 75 feet anchors consisting of about 300 pounds of scrap iron were attached to the cable by galvanized wire bridles 50 feet long and prevented the cable from being swept down stream as it was laid, also maintaining it in position on the bottom until it had settled well into the mud and silt of the river bottom.

PIPE JOINTING

The sections of pipe 20 feet long, were jointed together by outside screwed couplings that were attached to one end of each piece as received. Where the topography permitted the field joints were usually made with machines except when additional gangs were employed to expedite the installation by hand work. In very rough and hilly country, the difficulty of handling the heavy machines made it more advantageous to couple the pipe by hand screwing with large pipe tongs. For this hand work there was required in each crew about 60 men who under favorable circumstances connected a maximum length of 2,500 linear feet in one 9-hour day.

There were installed on the work two pipe screwing machines built at Kansas City by the California Pipe Line Machine Co., each of them weighing 7,000 pounds, driven by a gasoline engine and operated by a total crew of about 40 men with a maximum record of jointing 8,200 linear feet of 10-inch pipe in one 9-hour day by 36 men who also made 24 bends and cleaned and painted the pipe. The 6-inch pipe of the Healdton-Cushing line was jointed entirely by the machines which had a record of laying 11,740 lin. ft. including 28 bends in one day with 26 men.

The joint screwing machine was mounted and traveled on the finished pipe where it was propelled by its own locomotive machinery. After the completion of each joint the pipe machine was moved 20 feet or one section length, to position for making the next joint, with the clutch overhanging the end of the pipe ready to grasp the forward section. While the machine was being advanced a man with a long pole pulled a full size oak plug through the last length of pipe, leaving it in the extremity to insure against any foreign substance being accidentally or maliciously left in the pipe. The plug remained constantly in the end of the pipe safeguarding it from the entrance of any obstructing material.

While this was being done, the next length of pipe in advance was lifted by six men who cleaned, oiled and served the screw thread with Crane's cement, and inserted it in the coupling while the forward end of the pipe was maintained in exact vertical position supported in a roller chain sling carried by a boom on the pipe screwing machine. The pipe thus supported was adjusted in exact alignment by another operation moving it as required transversely and maintaining it there while the clutch was attached to it, enabling the machine operator to start the engine and screw the pipe, penetrating the coupling about 2 1-4 inches. The last two or three turns were made with slow speed back gear drive on the clutch.

When the joint was completely screwed up an oak beam was inserted in the forward end of the pipe and its projecting end supported on a movable trestle about 2 feet high. The machine operator then lifted the pair of vertical legs from their bearing on the surface of the ground allowing the oak beam to take bearing support on the trestle while the machine advanced on the pipe until the clutch cleared the coupling and the machine legs were screwed down again until they took bearing and picked up the weight of the pipe, releasing the oak beam and trestle and thus permitting the next section of pipe to be inserted and the operations repeated. The jointing crew was followed by a gang of four men that cleaned the pipe and coated it with a bitumastic protective compound.

PIPE BENDING AND LAYING

In order to conform as nearly as possible to the profile of the alignment and reduce the tension on the screw joints, the pipe was carefully bent to correspond closely to vertical curves. This was accomplished, without heating the pipe, by two bending machines that did the work in about one-fourth the time required for hand operations. This machine consisted of two clamps encircling the pipe and securely bolted to it, that were connected by a wire cable passing over a 25-ton jack operated by power transmitted to it through a shaft parallel to the pipe operated by the screwing machine. In this way the jack applied at the center of a pipe length would quickly bend it to an ordinate of from 2 inches to 3 feet as required.

As soon as the pipe was jointed, painted and bent, it was lowered into the trench in the quickest and easiest manner and in any convenient length, and allowed to adapt itself to bearing, special care being taken to give it as much slack as possible; in other words to make the pipe as long as could be accommodated in the wide trench so as to provide for contraction and thus reduce stress in the threads which might otherwise be stripped or develop leaks when the temperature of the pipe was materially lowered. The backfilling followed closely after the laying and care was taken sometimes to cover the pipe at night when it was as cool as possible. As the backfill was loosely placed in position and its depth was small, the pressure was not sufficient to interfere with the slight automatic adjustments in the alignment of the pipe. Excess length was guarded against to avoid the possibility of the pipe buckling and upheaving out of the trench if greatly expanded by midsummer temperature.

RIVER CROSSING

The crossing of the Mississippi River was made with about 3,000 feet of submerged pipe laid in three days by a crew of 20 men. The pipe was assembled in the usual way with screw couplings and without flexible joints, and was tough enough and possessed sufficient strength to endure without injury any installation stresses due to deflection and other construction operations. Each of the submerged joints was however reinforced or stiffened by an exterior sleeve about 42 inches long, made with three longitudinally flanged segments bolted together and firmly gripping the pipe and coupling.

At each end of the submerged portion there was also provided, to relieve stresses from temperature expansion and contraction, a special high pressure expansion joint having a spigot end inserted with packing in a long hub and both hub and spigot pieces connected by longitudinal tie bolts through cast steel flanges.

The pipe was laid with a derrick barge served by a smaller barge which delivered materials, both of them being moored in position by long anchor lines permitting them to be advanced as successive portions of the pipe were added. The anchors were moved and the material barge was handled by a small river steamer used as a tender.

The pipe was assembled on the deck of the derrick barge and the couplings were screwed up by four pairs of hand tongs operated while the forward or upper end of the pipe was held in position suspended from the derrick boom and guyed to cleats on the deck of the barge and the lower end engaged the last section of the jointed pipe projecting above the surface of the water in an inclined position supported on the edge of the boat.

As fast as the joints were screwed the pipe was painted, the reinforcing sleeves were bolted on over the couplings, the end of the pipe was lifted by the derrick, and the barge moved 20 feet transversely, allowing the pipe to settle below the surface ready for the addition of another section.

After the pipe was laid across the river, a preliminary test was secured by talking through the pipe from one end to the other. Conversations could thus be distinctly heard, proving that there was no external leakage. The strength of the joints was proved by subjecting the pipe afterwards to a hydrostatic test which it satisfactorily passed.

PRESSURE TEST

After the land pipe was assembled and laid and the trenches backfilled, it was subjected to an hydrostatic test of 850 pounds pressure per square inch applied in sections about 80 miles long reaching from pumping station to pumping station.

The first section was filled with water delivered to it by several hours operation of an auxiliary steam pump. After the pipe was filled the valves at both ends were closed, the tap screws in the summits were opened to allow the escape of entrained air, and were then permanently closed by steel screw plugs.

Pressure was then developed up to 850 pounds by the station pumps, recording pressure gages having been connected at both ends of the section. The required pressure was usually attained in a short time and was maintained while the line was patrolled and inspected for any leaks that might be disclosed. In such cases they were readily observed, notwithstanding the small amount of loose backfill, and were generally easily corrected by calking.

After the completion of the test, oil was pumped into the pipe displacing the water and forcing it into the next section beyond, where it became available for the hydrostatic test, thus effecting considerable economy of time and of water, the latter being rather scarce in this region. In this way the same water was used and re-used five times for testing the whole line. The work was executed under the direction of Wynn Meredith, a member of the contracting firm.

The total weight of the 2,300,000 feet of 10-in. pipe installed was about 48,000 tons, requiring for its shipment 1,264 freight cars that if made up into a solid train would have had a combined length of more than 10 miles. The greatest number of men simultaneously employed was 1,554, the greatest number of animals was 836; there was 6 motor trucks and 28 automobiles used on the installation.

PUBLIC WORKS

Published Weekly
by
Public Works Journal Corporation
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba . $3.00 year
All other countries .... $4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

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Submerged Rock Excavation and Concreting

The construction of one of the largest, most costly and up-to-date steam and electric power developments has included expensive submerged dredging, rock excavation and concreting in New York City, which has been rapidly and successfully executed at a cost of more than one million dollars, as described in this issue.

The location of this work where submarine appliances and all kinds of heavy construction plant and equipment were easily available, together with the services of expert contractors familiar with work of a similar nature, afforded an opportunity, which has been well improved, to do the work with the most advantageous methods and the most experienced organizations and suitable equipment that could be selected.

The work was done on a unit price, competitive bid basis and great pains and ability were devoted to selecting methods, arranging schedules, and to the installation and operation of plant to the satisfaction of the owners and to the advantage of the contractors, so as to assure the rapidity of first-class economical construction with a minimum of waste or unnecessary expense. Although the details of the plans may not fit conditions in other places, the general features exemplify advanced practice and satisfactory equipment for heavy work, and their principal features are subject to modification for other large jobs.

The quantities were large enough to justify considerable initial expense in the installation of plant to reduce the unit cost of the work and a broad-gage policy was adopted in the preliminary construction of two separate and independent traveling plants for the mixing, hoisting and distribution of concrete to all parts of the work by the spouting system, which eliminated service tracks, derricks, cableways and the like, and insured rapid continuous service at a small operating expense. This system also served for handling plant and materials, and after the completion of the work will yield a considerable percentage of salvage in the shape of standard apparatus and serviceable trestle timber.

Submerged rock was advantageously removed partly by a rock breaker and dipper dredge and partly by drilling and blasting, and the water jet and suction dredge were utilized for removing small fragments and cleaning the bottom surface.

The construction of the massive wall in alternate section, by tremie methods, permitted the use of simplified and smaller numbers of forms, which were designed to be connected and disconnected by divers, and insured the rapid construction of a satisfactory wall. Forethought in scheduling and building the sea wall and shore retaining wall enabled the permanent structure of the former to be utilized for the major part of a large cofferdam and permitted a large area to be unwatered for more rapid and economical excavation and the construction therein of a large amount of concrete work that virtually provided a discharge tunnel, built in the dry, and without any tunneling operation.

In the construction of the piers supporting the wharf beyond the sea wall, difficulties from the great irregularities in the depth of the water were overcome by building the land ends of the cofferdams (which were in shallow water) with wooden panels, and the river ends, in deep water, with steel sheet piles, permitting the cofferdams themselves to serve as forms for the concreting. Throughout the work the appreciation of local conditions and important requirements enabled opportunities and available resources to be well balanced for simple operations and rapid construction.

Discretion in Zoning Ordinances

Several zoning ordinances adopted during the past few years have given to some board or commission certain discretion in the enforcing of restrictions on building, for reasons explained by Edward M. Bassett in a paper published in the August 6th issue of Public Works. As he stated: "The strict word of the law may sometimes be the height of injustice. No zoning ordinance standing by itself can provide for the proper adaptation of the spirit of the law to each exceptional case."

In making provision for discretionary application of the law, however, local authorities should make sure that they are not violating the law under which they act or surpassing their powers. As noted in the "Recent Legal Decisions" published in our September 10th issue, the village of South Orange, N. J., was held by the Court of Chancery to have invalidated its ordinance by providing therein that the board of trustees may use its discretion in granting permits for the erection of certain buildings in districts where forbidden by the general terms of the ordinance.

The state law granted to municipalities power to fix zones within which certain businesses and buildings may be forbidden, but it was held by the court that the restrictions must be imposed uniformly and must be obligatory upon all persons and property alike throughout the zone. "The discretionary powers reserved to the trustees by the ordinance to give to one and withhold from another the privilege of violating the ordinance is not conferred by the act."

Where state laws are so worded as to permit municipalities to provide for discretionary enforcement of specified restrictions it is, of course, legal and proper for them to do so. Most cities which have adopted zoning ordinances have found discretionary application necessary and it is probable that efforts will be made to change the New Jersey law in this respect.

Wilful Idleness

Following the public announcement of the president of the American Federation of Labor that the organization will resist to the utmost any reduction of wages and that laborers are entitled to "ice cream for their lunch and to automobiles to carry them to and from their work" and his appeal to the United States government to provide for 5,700,000 alleged unemployed in this country that the federation's demands should thus receive pay for little or no work, the New York Tribune has just published the result of an investigation made by it of the 500,000 said to be unemployed in New York City. Of this number 40 per cent are transients with their homes in other places. If these were eliminated the experts conducting the investigations report that the conditions would be little more than normal. They also report that a greater number of these unemployed are unwilling to work in hot weather or will not look for work at all.

The fact is that strike benefits, misplaced charity, and the tolerance of a long suffering public have encouraged the lazy, the discontented and the seditious in their dangerous and shiftless practices and a very large portion of the unemployed (who are in reality much fewer than are stated, probably not seriously more than normal) are idle through their own free will. Many of them demand exorbintant wages and are willing to do very little work in return. If they, as a class, would accept reasonable wages and endeavor to work vigorously and steadily, very few would fail to find employment. None would be idle if to this were added a reasonably efficient clearing house system for distribution of labor to different localities and different interests. There is no lack of employment and with reasonable and reliable labor a vast amount of production and construction would be resumed which would call for far more than the available present supply of labor and pay it excellent wages. There are today factories in New York unable to fill their urgent orders because they cannot possibly secure enough labor even at union or higher wages. Universal employment in this country chiefly needs the will to work and the unlearning of some of the pernicious customs that have spread so widely during the last few years.

Standard Size of Paving Brick

In spite of the standard specifications for paving brick adopted by the American Society for Municipal Improvements and the Society for Standardizing Paving Specifications, which specifications have been very widely adopted, it appears that the manufacturers are still called upon to turn out fourteen sizes and styles of brick. The National Paving Brick Manufacturers' Association has appointed a Committee on Elimination of Excess Variety, which committee met on August 30 with representatives of the United States Bureau of Standards, Department of Commerce and Chamber of Commerce to discuss the possibility of greatly reducing this number. At this meeting it was decided to call a conference of representatives of the principal engineering organizations to obtain their views of the matter.

As in all other industries, a reduction in the number of sizes and types of brick which manufacturers are called upon to turn out would undoubtedly reduce the cost of manufacturing, and a part, at least, of this reduction would probably be passed on to the consumer. In addition to this, both manufacturer and consumer would benefit by the larger stock of brick of each standard size that could be carried in stock and thus the greater promptness with which the consumer could be supplied. If the number of standards could be cut down to two or three, each manufacturer could carry a reasonable stock of each of these and supply any demand on short notice; whereas with ten or a dozen sizes and styles, his stock on many of these might be very low a considerable part of the time, although his stock as a whole might be as large as it was prudent to carry.

With demands for wire-cut brick, repressed, sharp edges, rounded edges, vertical fibre, etc., it does not seem possible that one standard can be adopted, but it does seem perfectly feasible to reduce the number to three or four, and it is to be hoped that such will be the result of the combined efforts of the various associations and departments now working to this end.

Road Work in Georgia

The state of Georgia has completed 62 new road projects in 36 counties at a cost of $3,000,000. In addition, 161 projects in 11 counties are under way involving an expenditure of $14,000,000, and plans are being prepared for 78 more projects in 53 counties at a cost of about $2,000,000.

Intensive Highway Work in Pennsylvania

The Pennsylvania state highway department will receive bids on September 27 for the construction of more than 63 miles of roadway divided into 30 projects, of which all except three or four are new. Of these 13 are one-course reinforced concrete, 12 are one-course reinforced concrete and hillside vitrified brick, while 5 offer an alternative between one-course reinforced concrete and a bituminous pavement—penetration bituminous macadam on a telford or broken stone base in one case, and bituminous surface course on a concrete foundation in the other four.

Municipal Bonds

Municipal bonds found a good demand and brought good prices during July and the first part of August, but the past month has seen the demand greatly diminished although the prices have continued favorable. Among the August sales were 5½ per cent bonds of Milwaukee, Oregon, Detroit, Toledo and the Philippin Islands; 6 per cent bonds of Milwaukee, South Dakota, Columbus and Toledo; 5 per cent bonds of Maine and Chicago, and the 4½s of San Francisco; these totaling $47,682,000 of the total $102,128,024 of municipal bonds sold during August. The sales for the first eight months of 1921 are reported by the "Bond Buyer" to have totaled $707,964,583.

Highway Telephone System for Missouri

The general manager of the Automobile Club of St. Louis, William King, is advocating the plan of placing a telephone box at each mile post along the main highways of Missouri, these telephones to be operated by central exchanges and to be used only by members of the automobile clubs maintaining the line, each member being provided with a private key for opening the telephone boxes. With such a system in operation a motorist who has experienced tire or engine trouble at a distance from a garage will always be within a half mile of a telephone station by which he can reach a service station in the nearest town. The plan contemplates about 1,600 telephones on the main highways connecting the large centers of population.

Public Control of California Hydraulic Power

It has been estimated that more than 9,000,000 h. p. can be developed from the mountain streams of California, less than 2,000,000 of which has yet been utilized. The rapid rate at which private companies are establishing hydro-electric plants in the state has aroused the interest of many of the citizens, who feel that these companies will, if they increase much more in size, wield a dangerous amount of economic and political power. It is proposed that a bill be passed by the California legislature creating a state water power board and empowering cities or groups of cities to contract with this board for the construction of publically owned power plants, thus virtually putting the state's capital and borrowing power behind municipal power ventures.

Water Supply in Metropolitan Districts

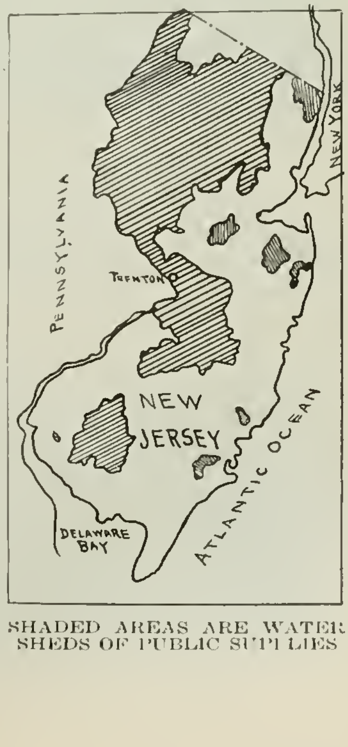
The problem of supplying water to the population of metropolitan districts is much greater than that in less populous sections, not only because of the increased amount of water required, but because the dense and wide-spread population adds greatly to the pollution of the supply available.

In the metropolitan district surrounding New York City this is found to an intense degree. This area includes the northern part of New Jersey, and the accompanying map shows, by the shaded areas, that almost all of the northern part of the state is included in watershed areas supplying the communities of this district; while another large area is found south of Trenton. (Other areas in the section additional to those indicated by shading on the map are now being developed for supplying the rapidly increasing population.)

A consequence of including in the watersheds the fairly populous districts as well as the woodlands is that it is necessary to treat all of the surface waters to render them safe for public supplies. In New Jersey 46 per cent of the urban population is supplied with water that has been filtered and much of it has also been chlorinated, while 31 per cent of the surface water has been chlorinated only. Only 1½ per cent of the urban population receives surface water that has not been treated at all.

In addition to this treatment of the water supplies, the state is quite stringent in its requirements for the purification of sewage, there being more sewage treatment plants, we believe, in the state of New Jersey than in any other equal area in the United States.

Some of the communities, especially those along the coast, find it possible to secure sufficient water from deep wells, but in the northern part of the state, at least, only the smaller communities have found this possible. As there is no reason to believe that the conditions will so change in character as to lessen these difficulties, but on the other hand it is to be anticipated that they will be intensified, the necessity for intelligent, scientific and rigorous control of the water supply problems of metropolitan areas by state federal authority is becoming daily more imperative.



SHADED AREAS ARE WATER SHEDS OF PUBLIC SUPPLIES

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Handle and Erect Girder Spans Without Special Equipment—VII*

With gallows frames, with moveable derricks and by floating.

Some plate girders in a bridge over the tracks of the Pennsylvania Railroad Company at Newark, N. J., weighing 54,760 pounds each, were unloaded from flat cars and erected by two pairs of tackles suspended from two high special gallows frames, spanning two tracks and fleeted on the piers and abutments of the bridge. The caps of the gallows frames were made with two tiers of heavy timbers, supported on 12 x 12-inch vertical posts securely braced to full length outside 10 x 12-inch batter posts, both vertical and batter posts being connected by scabs to full length transverse sills. A pair of heavy tackles suspended from each gallows frame were connected to plate hooks engaging the top flanges of the girders and enabling the latter to be lifted and lowered and to be fleeted transversely from side to side of the gallows frame in order to clear the delivery track and set them in required position.

A very heavy 123-foot plate girder 9½ feet deep was unloaded from the cars in Philadelphia by a special gallows frame of unusually wide span, with three heavy tackles engaging yokes connected to the girder at the center of gravity by steel screw rods. The tackles were suspended from heavy oak ties placed across the top flanges of a set of 9 I-beams seated on a pair of plate girders that were borrowed from an adjacent structure and supported on timber bents about 70 feet apart, thus affording a wide clear span under which the girder was delivered on a skew track from which it was lifted by a locomotive hauling on the lead lines from the tackles. After the girder was hoisted clear of the car and the tackles removed, the girder was revolved horizontally around its center of gravity, and the ends being guided by tag lines, was lowered to position on the abutments, after which the tackles were moved in the gallows frame to a position over the center of gravity of the second girder, which was unloaded and erected in the same manner. The gallows frame itself was erected and dismantled by a large stiff-leg derrick.

In central Ohio a considerable number of short span truss bridges were replaced a few years ago by plate girder spans, a part of which were of the through type with a maximum length of 90 feet and weight of 36 tons.

The old spans were removed and the traffic carried on trestle falsework on which the new girders were successively delivered, loaded on flat cars. The girders were received with their webs horizontal and were unloaded by two tackles attached to the top and bottom flanges at each end and suspended to the gallows frames seated on the piers and abutments. The tackles were operated to lift the girders free of the cars and after the tackles were removed the bottom flange tackles

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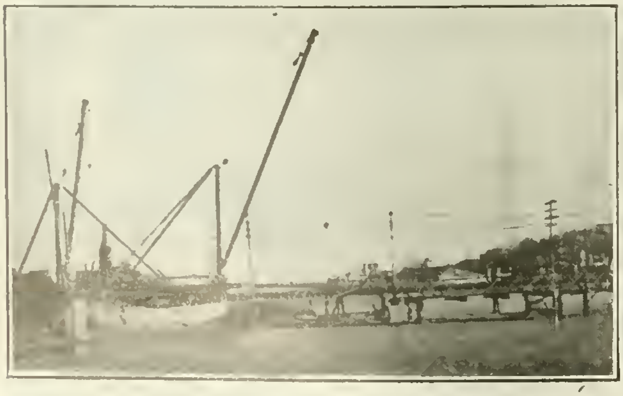
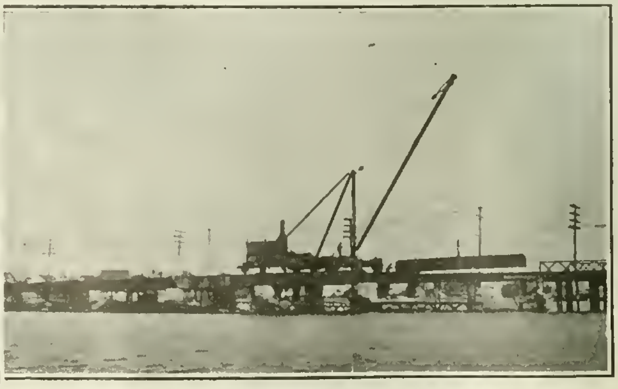
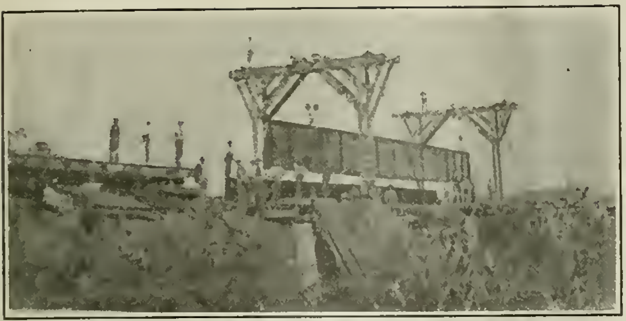
*Part I.—Transportation to site and erecting by steam protrusion was published July 3.
Part II.—Erection by cribbing, jacking, rolling and skidding was published July 30.
Part III.—With fixed derricks was published August 6.
Part IV.—With locomotive cranes, derrick cars and wrecking cars was published August 13.
Part V.—With locomotive cranes, derrick cars and wrecking cars, was published August 20.
Part VI.—With gallows frames, was published August 27.



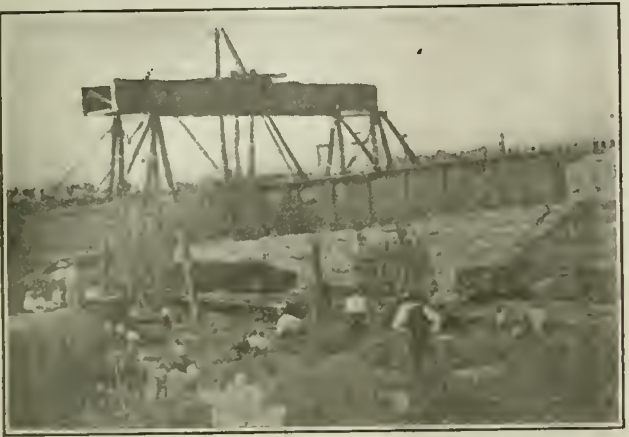
REMOVING FIRST SPAN OF OLD TRUSSES, ASBURY PARK BRIDGE



ERECTING 8TH SPAN GIRDER, ASBURY PARK BRIDGE



PAIR OF DOUBLE-BENT GALLOWS FRAMES WITH INSIDE AND OUTSIDE KNEEBRACES



ERECTING LONG PLATE GIRDER WITH TRIPLE TACKLES MOVABLE ON SPECIAL LONG-SPAN GALLOWS FRAME

were slacked off and the top flange tackles were operated to revolve the girder into a vertical plane and then the tackles were manipulated to fleet the girder to one side of the track and lower it to bearing on the substructure. The work was done with great rapidity, one girder being unloaded and seated on the abutment in six minutes. Only 10 hours were required to erect a pair of girders, complete the floor and remove the old span.

There were also deck spans having four plate girders, that were unloaded by the gallows frames and set outside the existing structures and jacked transversely into position, erecting the new spans in successive halves while the traffic was maintained on the old structure and the latter removed after it was transferred to the first half of the new structure.

The 114½-foot plate girders 9½ feet deep for the Janesville bridge in Wisconsin were unloaded by a pair of double-bent gallows frames with clearances 21 feet high above the track and 13 feet wide. The bents of the gallows frames were made with 8 x 16-inch horizontal caps and 12 x 12-inch plumb and batter posts, and were braced together 5 feet apart and seated on longitudinal sills supported on falsework piles at the elevation of the top of the masonry. Hand windlasses were installed on longitudinal timbers, supported by the double caps between which the hoisting lines from the windlasses were suspended.

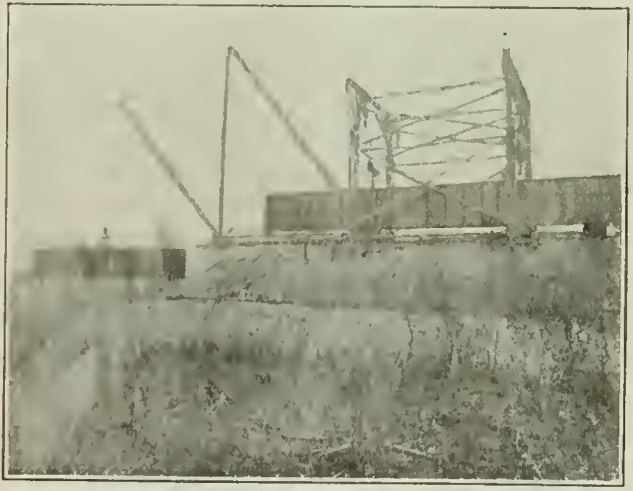
The gallows frames although independently stable were, for additional security, guyed together and were guyed to anchorages on shore.

The girders were lifted by the windlasses, the cars removed, the girders lowered to the substructure, windlasses shifted 6 or 8 feet on top of the gallows frames, girders again lifted and swung laterally, and the operations repeated until they were carried as far as required transversely and placed in their final positions.

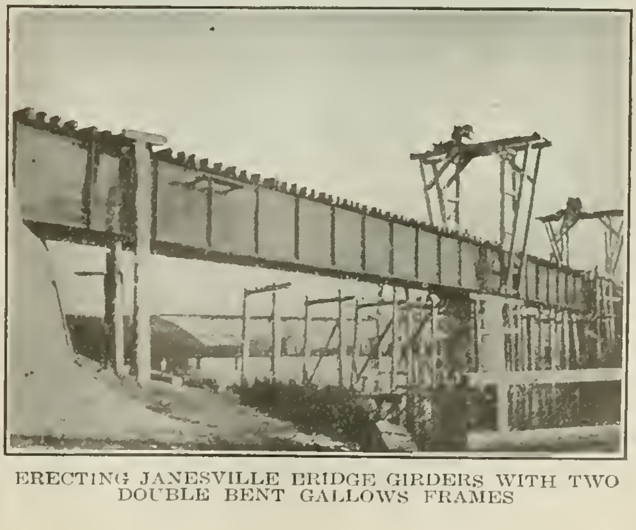
MOVEABLE DERRICKS AND FLOATING

The use of moveable derricks for girder erection differs from that of fixed derricks (described August 6, page 116) only in the greater convenience derived from ability to shift the plant quickly. A good illustration is in the case of the Asbury Park bridge renewal where old and new spans of the superstructure were rapidly handled by a moveable stiff-leg derrick installed on a flat car.

In the comparatively rare cases where girders can be delivered to the substructure on scows or barges, if the bridge floor is not too far above water level the girders may sometimes be unloaded and erected entirely by manipulation of their floats. If there is a sufficient range of tide the girders may be floated between the piers at high tide, and be automatically deposited on their seats by the falling tide which, continuing, releases the float and permits it to be removed. If there is no tide the same results may be attained by floating the girder to position slightly



UNLOADING HEAVY GIRDERS WITH PAIR OF GALLOWS FRAMES BRACED TOGETHER FOR INDEPENDENT STABILITY



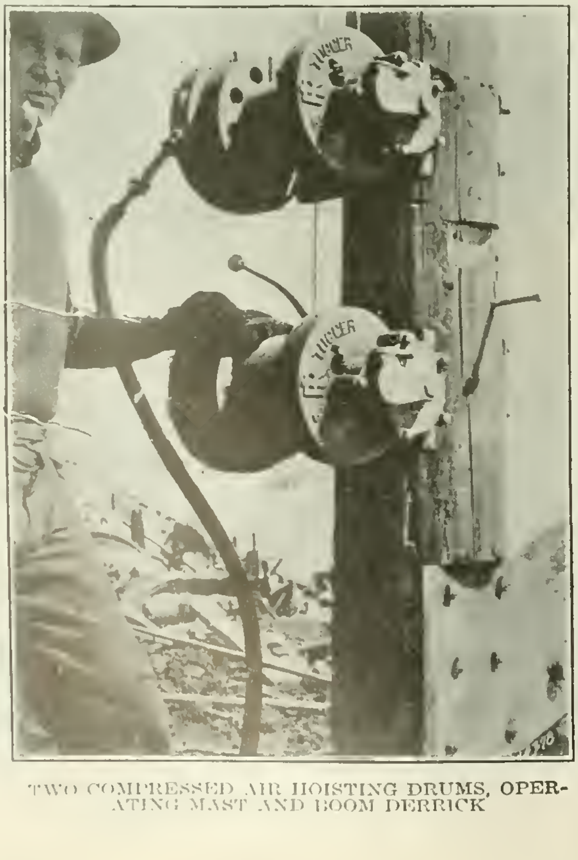
ERECTING JANESVILLE BRIDGE GIRDERS WITH TWO DOUBLE BENT GALLOWS FRAMES above the elevation of the permanent position and then sinking the float a few inches by the addition of water ballast.

Harvard bridge across the Charles river, Boston, has 23 spans from 76 to 106 feet in length, each with four main longitudinal plate girders. The single girders were riveted up complete at the bridge shop and taken on separate trucks to an assembling yard at the water's edge where they were stored and riveted together in braced pairs that were loaded on the deck of a special scow that was then towed to the bridge site and placed between the piers upon which it was gradually deposited by partly scuttling the scow with water ballast, easily secured by withdrawing plugs that closed special inlet valves in the bottom of the scow.

If the adjustment was unsatisfactory the rising tide still sufficed to raise the girders clear for a second lowering. The scow was then beached and the water automatically drained out of the valves at low tide, after which, before the tide rose, the valves were closed and the scow taken back to the assembly yard for another load next high tide. The conditions of manufacture and erection were unusually favorable in this case and were ingeniously availed of.

A Small Derrick Operated by Two Hoists

Under this heading we published last week a description of a home made derrick, utilizing telegraph poles and two small hoists operated by compressed air. We intended to publish with this a sketch and photograph of the derrick, which, however, were inadvertantly omitted and are shown herewith. The description will be found on page 199.



TWO COMPRESSED AIR HOISTING DRUMS, OPERATING MAST AND BOOM DERRICK

Wisconsin State Highway Construction

Owing to the failure of the legislature to provide for the highway construction, the state department of engineering has issued a statement that it may be necessary to effect a radical reorganization of the entire department, and that plans to that end are now under consideration.

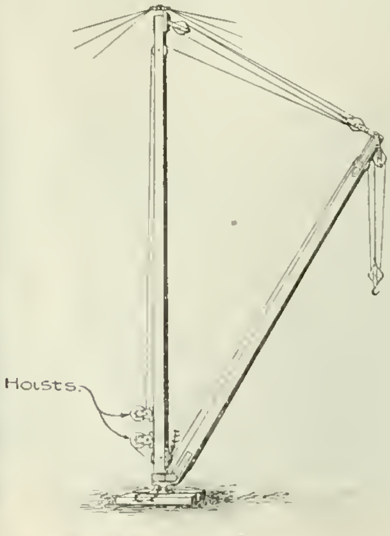
For the last three or four years the state highway construction in Wisconsin has been restricted, considerable unexpended balances of highway funds have accumulated and plans have been made for a large mileage of roadway. The present economic situation has reduced the price of labor and materials and there are now adequate supplies of both, which, in connection with the large funds available, have caused the present construction to progress at an unprecedented rate.

In June, 1921, the State Highway Commission had under way 310 miles of state highway concrete pavement, of which 51 miles were hold-over contracts and it is expected that the total construction for this season will be about 325 miles plus 1,200 miles of road surface with other kinds of material in addition to 600 or 700 miles of grading, making a total of about 2,200 miles of improvements.

There are now at work about 175 construction crews building gravel roads and 60 concrete paving mixers in operation that have a combined output of more than 3 miles per day. Five important jobs, including two concrete pavements, are being conducted by day labor operation.

The maintenance of the state trunk highway system is improved on account of the greater facility of securing good patrolmen and weather conditions that have permitted earth and light gravel sections to be put in shape. The county authorities are remiss in putting up the necessary detour signs. From June 12 to September 16 the highway department has published the Highway Information Service, blue prints of the state highway trunk systems, showing lakes, streams, places of interest and types of road, together with all construction jobs under way and detours marked good, fair, or poor, as the case may be. These are published weekly and sold to subscribers at $10 for the season, a sum which just about covers the actual cost. There are at present about 60 subscribers for this service, which it is expected will be increased to 100 and include hotels, garages and chambers of commerce.

The department has under construction $826,650 worth of bridges of a total length of 6,018 feet.



HOME MADE DERRICK OPERATED BY COMPRESSED AIR

Recent Legal Decisions

STATUTE AUTHORIZING IMPROVEMENTS ON PETITION OF MAJORITY OF OWNERS HELD VALID

The Colorado Supreme Court holds, Gillum v. Town of Rifle, 197 Pac. 1017, that Rev. St., 1908, Sections 5359-5405, permitting an incorporated town to make public improvements upon the petition of the owners of a majority of the frontage to be assessed therefor, and affording such owners notice of the assessment for special benefits and an opportunity to be heard upon the quantum of the tax and upon its validity, is not in violation of the Fourteenth Amendment as depriving such owners of property without due process of law. The court followed Londoner v. Denver, 52 Colo. 15, 119 Pac. 156, which sustained a similar provision in the Denver charter.

CALIFORNIA MUNICIPALLY OWNED PUBLIC UTILITIES NOT SUBJECT TO RAILROAD COMMISSION

The California District Court of Appeals, First District, following City of Pasadena v. Railroad Commission of California, 192 Pac. 25, holds that the Public Utilities Act has no application to any public service carried on by a municipal corporation under the authority of the Constitution and laws of the state. Therefore it is unnecessary for a municipality, before constructing an electrical distributing system to supply the municipality and its inhabitants with electric energy in connection with its authorized aqueduct system, to apply to the commission for a certificate of public convenience and necessity.—Los Angeles Gas & Electric Corporation v. Department of Public Service of City of Los Angeles (Cal. App.), 197 Pac. 962.

METHOD OF DETERMINING MARKET VALUE OF WATER SYSTEM PURCHASED BY MUNICIPALITY

A city having elected to purchase the water works system built and owned by a water company in the city under the provisions of the ordinance contract between the parties, it became necessary to determine the purchase price which in equity and good conscience the city should pay. The federal district court for the District of Kansas holds, in a suit in equity for this purpose, Wichita Water Co. v. City of Wichita, 271 Fed. 973, that the replacement or reproduction method of ascertaining the fair and reasonable market value of a public utility property, such as that involved in this case, is the established method employed in the making of such ascertainments, if a fair and reasonable amount for its going value be added, and, having thus determined the replacement value from such aggregate sum, there is deducted such reasonable sum or sums as will fairly and justly measure the difference in value between the new plant so reproduced, with new materials used in the reconstruction, and the depreciation in value of the old plant, occasioned by long use, erosion, corrosion, and electrolysis of the mains, obsolescence, and, in short, all and everything which tends to lessen the life of the plant or depreciate the value of the old as compared with the cost of the newly constructed system.

It was held to be error to exclude the cost of recutting and replacing pavements over the water mains, although the pavement was laid by the city after the water mains were laid by the company. The court distinguished, on this point, the case of Des Moines Gas Co. v. Des Moines, 238 U. S. 153, 35 Sup. Ct. 811, where the Supreme Court of the United States did exclude from the replacement value of the plant involved in that case the cost of placing mains, pipes, etc., underneath the paving and macadam works of the city, for the reason that the question in that case was one of just rates of service to be charged the consumers of gas, and was not one as to the fair market value of the plant, based on its replacement theory.

RATES OF PUBLIC UTILITIES FIXED BY FRANCHISE ORDINANCE ARE SUBJECT TO LEGISLATIVE CONTROL

Rates or tolls to be charged by a public service corporation for services rendered, fixed by a municipality by ordinance as an incident to the granting of a franchise to it by such municipality, are held by the Florida Supreme Court, Town of Brooksville v. Florida Telephone Co., 88 So. 307, to be subject to legislative control.

PURCHASE OF PROPERTY BY MUNICIPALITY UNDER AGREEMENT TO IMPROVE IT

The West Virginia Supreme Court of Appeals holds, Whittaker v. City of Huntington, 107 S. E. 121, that a municipal corporation, whose charter empowers it to open, maintain, and control public streets and bridges within the city, to acquire, lay off, and control public grounds, squares, and parks for the convenience of its inhabitants, and to purchase, condemn, lease, or contract for the real estate necessary to effectuate such purposes, lawfully may enter into a contract with an owner of land within its boundaries whereby, in consideration of his voluntary conveyance to the city of certain portions of his property which he was preparing to develop, ornament and improve for the benefit of other land owned by him, in order to render it attractive to prospective purchasers of sites for homes, by the construction of bridges and boulevards and the opening and dedication of a public park thereon, the city undertook to complete and maintain such improvements, without further expense to him, and in accordance with a park and boulevard plan which it theretofore had adopted. Having acquired the property pursuant to such an agreement, it is held the municipality may not lawfully retain it and at the same time decline to fulfill its portion of the agreement, and the former owner, acting in good faith, may recover damages for loss sustained by the breach.

NEWS OF THE SOCIETIES

Sept. 12-26 — AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS. Wilkes-barre, Pa.

Sept. 19-21—ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA. Chicago, Ill. Secretary, P. J. McAndrews, C. & N. W. Ry., Sterling, Ill.

Sept. 19-23—INTERNATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONER. Chicago. Secretary, Ethelbert Stewart, U. S. Bureau of Labor Statistics, Washington, D. C.

Sept. 19-24—ASSOCIATION OF IRON AND STEEL ENGINEERS. La Salle Hotel, Chicago, Ill.

Sept. 19-24—NATIONAL DRAINAGE CONGRESS. St. Paul, Minn.

Sept. 20-23—WEST VIRGINIA- KENTUCKY ASSOCIATION OF MINE MECHANICAL AND ELECTRICAL ENGINEERS. Annual convention. Huntington, W. Va.

Sept. 23—AMERICAN S OCIETY OF MECHANICAL ENGINEERS, METROPOLITAN SECTION. Enginering Societies Building, New York City.

Sept. 26-30 — ILLUMINATING ENGINEERING SOCIETY. Rochester, N. Y, Illuminating Engineering Society, Chicago Section, Chicago with National.

Sept. 26-30 — NATIONAL SAFETY COUNCIL. Boston, Mass.

Sept. 27-30—LEAGUE OF CALIFORNIA MUNICIPALITIES. Annual convention. Santa Monica, Cal.

Sept. 28 (10 Days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Sept. 23-Oct. 9—NATIONAL CONGRESS OF ENGINEERS. Buenos Aires.

Sept. 29-Oct. 1 — PENNSYLVANIA STATE ASSOCIATION OF COUNTY COMMISSIONERS. Annual convention. Harrisburg, Pa. Secretary, L. C. Norris, Clearfield, Pa.

Sept. 29-Oct. 1—AMERICAN ELECTROCHEMICAL SOCIETY. Lake Placid, N. Y.

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventth annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 3-7 — AMERICAN ELECTRIC RAILWAY ASSOCIATION. Atlantic City, N. J.

Oct. 5-7 — SOCIETY OF INDUSTRIAL ENGINEERS. National convention. Springfield, Mass.

Oct. 8—BROOKLYN ENGINEERS' CLUB. Dinner. Chamber of Commerce.

Dec., 22-23—KANSAS ENGINEERING SOCIETY. Hutchinson, Kan.

Oct. 11-14 — INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 11-14—AMERICAN ASSOCIATION OF PORT AUTHORITIES. Annual meeting. Seattle, Wash, Secretary, M. P. Fennell, Jr., 57 Common St., Montreal, Canada.

Oct. 12-14 — LEAGUE OF KANSAS MUNICIPALITIES. Annual convention. Lawrence, Kans. Secretary, John G. Stutz, University of Kansas.

Oct. 20-21 — CITY PAVING CONFERENCE. Engineers Club of Philadelphia, 1317 Spruce St., Philadelphia. H. E. Hopkins.

Oct. 20-21—OHIO STATE CONFERENCE ON CITY PLANNING. Annual conference. Columbus, Ohio. Secretary-treasurer — Charlotte Rumbold, Chamber of Commerce Building, Cleveland.

Oct. 24-28 — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5 — NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-16—CITY MANAGERS' ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

Nov. 16-18 — NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

Nov. 17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Society of Naval Architects and Marine Engineers. New York.

Nov. 17-18—SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS. New York.

NATIONAL PORT PROBLEMS

Meetings to discuss National Port Problems were held pursuant to notices issued by the American Society of Civil Engineers, at the Engineering Societies Building, September 7th and 8th, 1921.

The principal addresses and papers scheduled to cover important features of the port interests included:

"National Phases of Port Problems," Frederic W. Cowie, Chief Engineer, Harbor Commissioners, Montreal, Que., Canada.

"Terminals," by Maj. Gen. Lansing H. Beach, Chief of Engineers, United States Army, Washington, D. C.

"Development of the Smaller Ports," by Frederic H. Fay, Member, Fay, Spofford and Thorndike, Consulting Engineers, Boston, Mass.

"Relation of Warehouses to Port Development," by M. A. Long, The M. A. Long Company, Engineers and Constructors, Baltimore, Md.

"Lack of Co-Ordination in Design of American Ports," by John Meigs, Consulting Engineer, Philadelphia, Pa.

"Brief Comparison of American and Foreign Sea Ports," by W. Watters Pagon, Consulting Engineer, Baltimore, Md.

"Some Observations on Port Finances," by Edwin J. Clapp, New York City.

"Improvement and Development of Ports," by Carroll R. Thompson, Assistant Director, Department of Wharves, Docks and Ferries, Philadelphia, Pa.

"Port Problems in New York," by John A. Bensel, Consulting Engineer, New York City.

"Relationship of Rail and Water Carriers," by W. J. Wilgus, Consulting Engineer, New York City.

"Port Administration," by B. F. Cresson, Jr., Chief Engineer, The Port of New York Authorities, New York City.

"Pier Designs as Developed from Quay Designs" (illustrated), by H. McL. Harding, Designing Terminal Engineer, New York City.

MINNESOTA BOARD OF REGISTRATION

The officers of the Minnesota Board of Registration for Engineers, Architects and Land. Surveyors are Paul Doty, St. Paul, chairman; H. T. Downs, Minneapolis, secretary-treasurer, and N. Y. Taylor, Litchfield, vice-chairman. The other members of the board are: F. W. McKellip, F. G. Gorman, A. F. Gauger and Dwight E. Woodbridge.

PERSONALS

Routh, James W., has recently been retained by the St. Paul Bureau of Municipal Research as consulting engineer and is now engaged in studying problems connected with street cleaning and refuse collection in that city.

Trueblood, Edwin E., has been appointed county engineer of Douglas county, Kansas.

Moore, DeWitt V., engineer and contractor, has been made secretary of the newly appointed Engineers' Registration Board of Indiana.

Bennett, J. Gardner, instructor of civil and municipal engineering in the University of Wisconsin, has been appointed city manager of Fort Myers, Florida.

Murray, Charles W., formerly city engineer of Miami, Florida, has been appointed acting director of the Department of Public Service for that city.

Hobbs, W. E., surveyor for the Manitoba Good Roads Board, has been appointed controller of town planning for the provincial government of Manitoba.

Burch, A. N., project manager, Orland project, United States Reclamation Service, has resigned, after serving since 1908.

Snyder, Frederick A., has been appointed resident engineer on the New York-New Jersey vehicular tunnel.

Foster, Samuel D., has been appointed consulting engineer of the Allegheny County, Pennsylvania, Planning Commission.

Hagis, A. B., has been appointed city engineer of Jellicoe, Tenn.

Dryden, F. H., has been appointed city engineer of Salisbury, Md.

Harrington, W. H., has been appointed city engineer of Tracy, Cal.

McCreath, Gib, of Atkinson, Neb., has been elected county highway commissioner.

White, C. R., has been appointed to take charge of the pumping station of the new water works system in Scarborough township, Ontario.

Gaudet, Col. F. M., director of public safety for Montreal, has been appointed manager and technical expert of the Honorary Advisory Council for Scientific and Industrial Research and R. A. Ross has been appointed honorary chairman of the council.

Ducharme, Stanislaw, has been appointed member of the board of water commissioners of the city of Chicopee, Mass.

Meserve, Albert W., town clerk of Kennebunk, Me., was elected trustee for that town of the water district board.

Scheiner, Walter R., has been appointed city engineer of Salina, Kans.

Ridley, Clarence E., has been appointed city manager of Bluefield, W. Va.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

A LOCOMOTIVE GRAVEL EXCAVATING SCREENING AND LOADING MACHINE

The screening and loading machine manufactured by the Jordan & Steele Manufacturing Co., Inc., is designed to excavate sand or gravel from the bank or storage pile, elevate it to a screen and load the graded product into cars, dump wagons or trucks alongside the track on which the machine runs by its own power.

The machine has a steel tower with adjustable steel frames for the elevator and conveying mechanism and with its gasoline motor is mounted on a steel truck. Under favorable conditions it can be continuously operated producing a large quantity of uniform size sand or gravel with a minimum of time, lost, and hand labor. The excavating buckets in the elevator are driven by sprocket chains and can be set on the foot of the stock pile when the machine is stationary and is served by shovelmen or, under favorable conditions, it can be readily advanced taking a strip of material the full height of the bank that is to be cut.

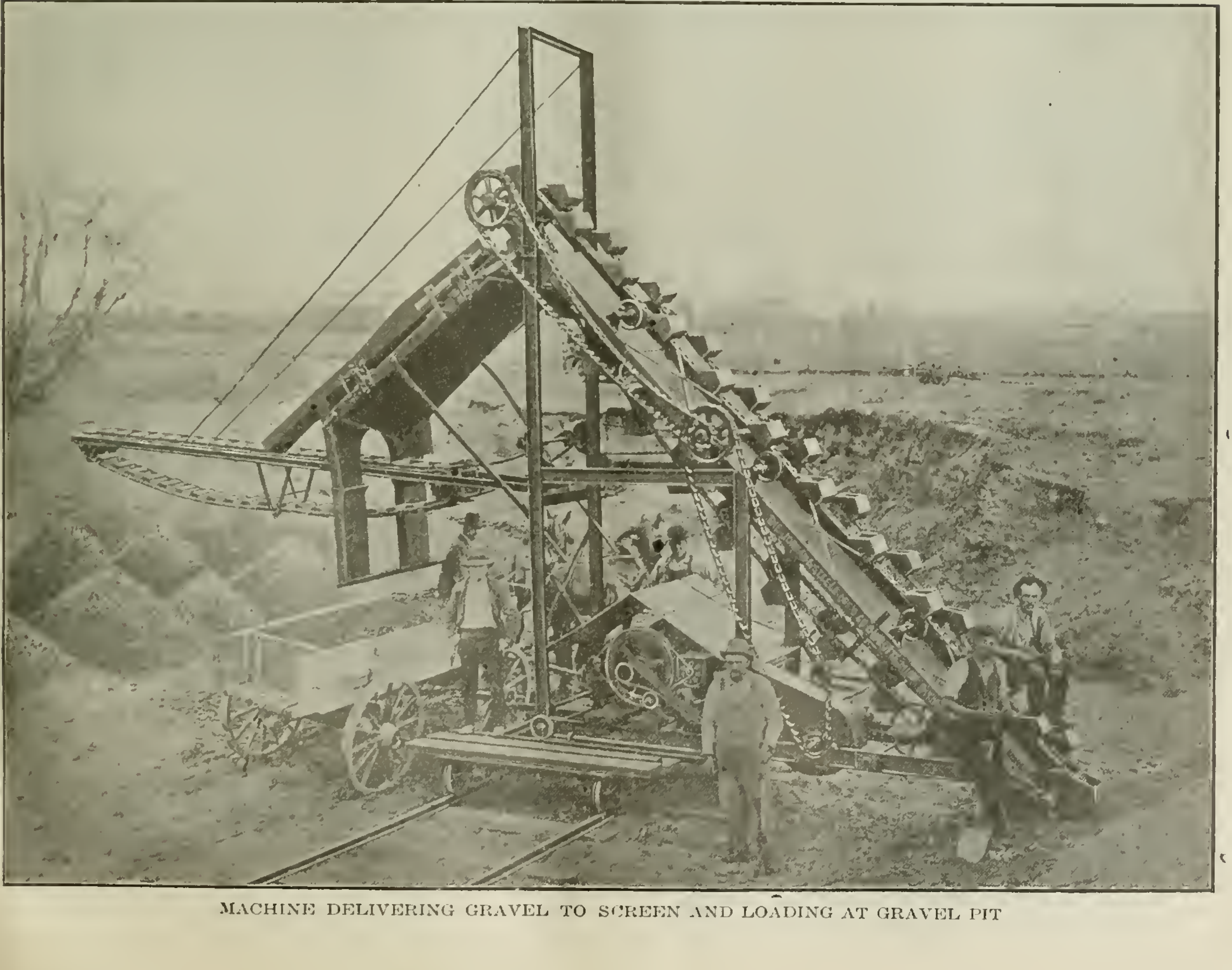
The machine delivers at sufficient elevation above the surface of the ground to enable it to fill buckets, cars, measuring boxes, trucks and wagons directly without the necessity for loading hoppers, storage bins or chutes and thus eliminates the installation and frequent shifting of such equipment. The large capacity of the machine makes it especially efficient on large concrete jobs and buildings where sand and gravel can be secured in local pits and delivered as required without involving rehandling or costly storage. It is operated by three men, has a capacity of one yard per minute, is not clogged by dirt or clay, and deposits the rejected material in piles clear of the machine.

SULTAN GASOLINE ENGINES, PUMPS, HOISTS AND SAW

Catalog 71 of the Whitman Agricultural Co., illustrates the Sultan contractors' equipment, including gasoline engines, pumps, oncrete mixers, saw rigs, hoists and boring tools.

The new Sultan engine has been especially designed for simple construction and for a service as nearly automatic as possible, to run without vibration, and noise and without requiring a licensed operator. The cylinders, of new design, have an improved cooling system, chilled cam gear, and a perfect timing device and circuit breaker. Has automatic regulation of speed by the fuel saving throttle control governor and the engine is dust proof and dirt proof and does not require housing. It is provided with an improved aluminum automatic carburetor and improved circuit breaker that is not affected by water or oil, is positive in action, cannot wear out or get out of order. The engine is made in 7 sizes of 1¾ to 8 h. p., with net weight of 200 to 900 pounds. It is recommended for operating concrete mixers and other kinds of contractors' equipment.

The Sultan double-acting power pump for street work, macadam roads and concrete work is made in four sizes, 2½ to 3 h. p., with a capacity of 900 to 1,750 gallons per hour to an elevation of 170 feet. It is mounted on a steel truck and can be operated at a cost of 35 cents for a ten-hour day.



MACHINE DELIVERING GRAVEL TO SCREEN AND LOADING AT GRAVEL PIT

The Sultan Imp portable force pump, especially designed to furnish water to concrete mixers, is made in three sizes, with motor or belt power, has a capacity of 275 gallons per hour. They also furnish a Sultan motor driven Imp force pump suitable for suction lift of 20 feet and tank pressure of 50 pounds.

The Sultan Atlas complete pumping plant to supply water for road construction has a double-acting pump that is made in three sizes of 1¾, 3 and 4 h. p. with a capacity of 650, 1,152 and 2,550 gallons per hour at a pressure of 75 pounds.

The Sultan direct drive power centrifugal pump with 2, 2½ or 3-inch suction and discharge pipes has a capacity of 150, 225 and 350 gallons per minute to a total lift of 30 feet. There is also a belt driven centrifugal pump made in nine sizes with suction pipe of 1 to 10 inches diameter and capacities up to 4,750 gallons per minute.

Sultan trench or diaphragm power pumps are made in four sizes with capacities from 3,500 to 6,000 gallons per hour. They are mounted on steel trucks, driven by a gasoline motor and are very effective for trench pumping and for handling water, lifting mud, sand or gravel.

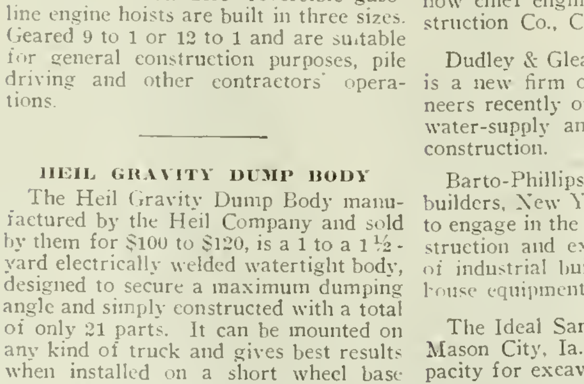
The Sultan builders' reversible gasoline engine hoists are built in three sizes. Geared 9 to 1 or 12 to 1 and are suitable for general construction purposes, pile driving and other contractors' operations.

HEIL GRAVITY DUMP BODY

The Heil Gravity Dump Body manufactured by the Heil Company and sold by them for $100 to $120, is a 1 to a 1½-yard electrically welded watertight body, designed to secure a maximum dumping angle and simply constructed with a total of only 21 parts. It can be mounted on any kind of truck and gives best results when installed on a short wheel base truck with pneumatic tires. It is especially serviceable for concret road building. It can be used equally well in the country or in the city and the bodies can be easily removed, making the trucks quickly available for other purposes.

Wet concrete is especially easily handled by it, for the driver is able to trip the body without leaving his cab. The body rolls over by gravity to a dumping angle of 80 or 90 degrees when the heavy control springs stop the movement without injurious jerk to the body or chassis. Afterwards the control springs help to restore it to the raised position.

In the raised position the front of the body rests against the stop that locks it and holds it firmly in position. The single bodies are made in four sizes, weighing from 390 to 475 pounds. Dual Bodies ranging in capacity from 1½ yards to 3 yards are fastened to a special subframe so that they can be mounted on any make of truck.



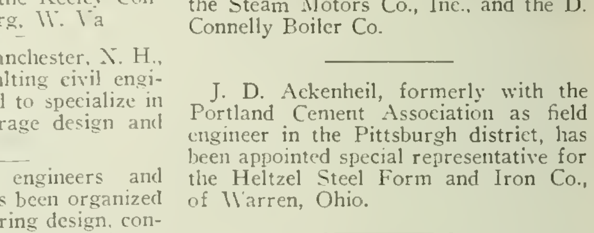
SINGLE BODY IN EXTREME DUMPING POSITION

HAVEMEYER CURB-BARS

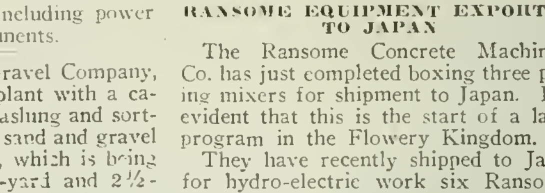
The Havemeyer round nose curb-bar weighs about 1½ pounds per linear foot and has a T-shape cross section with curved flanges and a straight web ¾ inch wide from which project anchors 2¾ inches long and 6 inches apart on centers. The anchors are staggered, that is, bent in opposite directions, for secure bond with the concrete. The curb-bar has no sharp edges so that no fillet is formed where trowelling takes place.

The bars are easily installed with the aid of soft wire ties hung on nails driven in wooden forms. The bars are made in 10 and 12-foot lengths, galvanized, and make neat compact bundles. For curves they can be readily bent without kinking. This can be done by contractor or will be done before shipping if so ordered.

The Havemeyer angle nose curb-bar is rolled from 1¼x1¼x3-16-inch angle with anchors 6 inches apart and 2¾ inches long sheared and punched from the top flange of the angle which is also provided with three rows of lugs to preent slipping. The bars weigh 1½ pounds per linear foot, are stocked in 10-foot lengths galvanized and cut to lengths or bent on order. They are used for shipping platforms and for stair nosings.



ROUND NOSE CURB BAR



ANGLE NOSE CURB BAR

INDUSTRIAL NOTES

W. H. Schimmel, formerly engineer maintenance of way, Monongahela Valley Traction Co., Fairmont, W. Va., is now chief engineer of the Keeley Construction Co., Clarksburg, W. Va

Dudley & Gleaser, Manchester, N. H., is a new firm of consulting civil engineers recently organized to specialize in water-supply and sewerage design and construction.

Barto-Phillips Co., engineers and builders, New York, has been organized to engage in the engineering design, construction and exportation of all classes of industrial buildings, including power house equipment requirements.

The Ideal Sand and Gravel Company, Mason City, Ia., has a plant with a capacity for excavating, washing and sorting 375 tons per hour of sand and gravel from a 260-acre deposit, which is being worked with three 1½-yard and 2½-yard dragline buckets delivering into 50-yard standard gauge, bottom dump cars hauled by locomotives to a track hopper from which the material is elevated to be crushed and then passes through revolving screens and washing bins and on to the storage yard of 75,000 tons capacity.

The Cochrane Steam Specialty Co. of Massachusetts has been organized with offices in Boston to represent in New England numerous well-known manufacturers of power plant equipment, including H. S. B. W.-Cochrane Corp., the Steam Motors Co., Inc., and the D. Connelly Boiler Co.

J. D. Ackenheil, formerly with the Portland Cement Association as field engineer in the Pittsburgh district, has been appointed special representative for the Heltzel Steel Form and Iron Co., of Warren, Ohio.

RANSOME EQUIPMENT EXPORTED TO JAPAN

The Ransome Concrete Machinery Co. has just completed boxing three paving mixers for shipment to Japan. It is evident that this is the start of a large program in the Flowery Kingdom.

They have recently shipped to Japan for hydro-electric work six Ransome-Canniff concrete mixers and placers and several Ransome-Canniff grout mixers and placers.

They have also recently shipped four 14-S mixers with gasoline engine, power loads and automatic water tanks to the Japanese army, to be used for the construction of new fortifications in Japan.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 SEPTEMBER 24, 1921 No. 13

Gastonia's Water Improvements

By W. A. Hardenbergh

Two-million-gallon filter plant, to replace outgrown tub filters, contains some novel features of construction, and the reinforcement is unusually heavy. No corrosive material in filter bottom.

With a population of nearly 25,000 at present, Gastonia, N. C., is one of the fastest growing cities in the south. Within the city limits are some 40 cotton mills, which fact is an index of the city's prosperity. During the past ten years Gastonia's growth has been extraordinarily rapid.

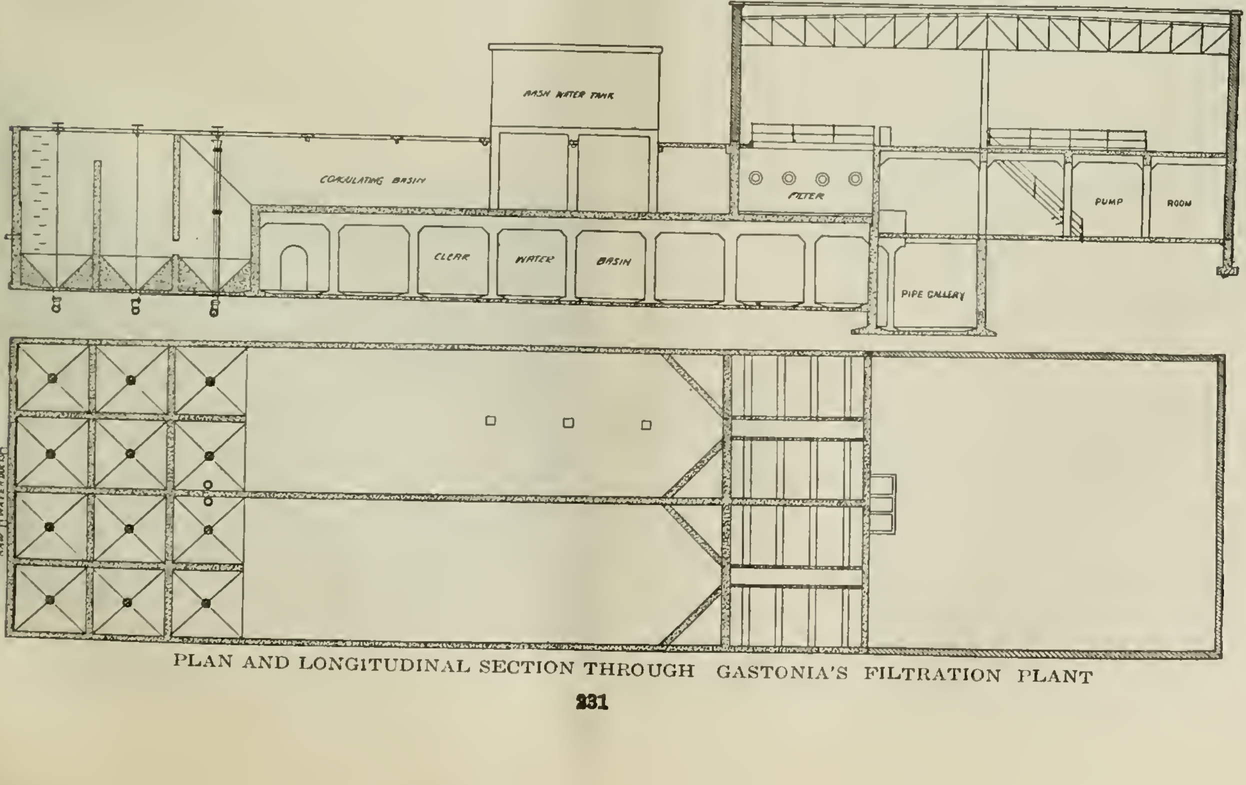
As with many other southern cities, the problems of sewerage and water supply were more or less neglected until the era of high-priced cotton brought to these places a new growth and much money. Gastonia is at present constructing a new sewage treatment plant, but heretofore she has turned her sewage into a convenient stream. Likewise, her water supply, while providing potable water, has been overworked and there has been no reserve for emergencies.

In addition to constructing a new sewage treatment plant and a new water filter, plans and surveys are now under way for nearly a million dollars of street paving.

The water improvements under way call for the erection of a filter house with two filter beds, coagulating and clear water reservoirs, and a high-pressure elevated tank. The total of the contract calls for an expenditure of approximately $110,000. When the new works are completed, the old plant will be used as a stand-by plant. The new filters will have a rated capacity of 2,000,000 gallons per day.

The source of the city water supply is Long Creek, a small stream about two miles north of the city. The water is pumped from this stream into a settling reservoir, from which it is forced through 9,400 feet of 12-inch main by electric pumps to the city filter plant.

The old plant consists of four tub filters, each



PLAN AND LONGITUDINAL SECTION THROUGH GASTONIA'S FILTRATION PLANT of about 250,000 gallons capacity per 24 hours, tub coagulation basins furnishing a detention period of only 40 minutes and a liquid chlorine apparatus. Aluminum sulfate is used for coagulant. There is no pressure tank, the electric pumps pumping against consumption. When the filters are being washed, pressure in the mains falls rapidly.

The raw water from the 12-inch line leading from the reservoir enters the new plant at the west end of the building, through four inlets. The mixing and settling chambers, where the coagulant will be thoroughly mixed with the raw water, are 35 x 44 feet, and the depth of water will be approximately 24 feet. These primary settling basins have hopper bottoms 11 feet square, with a clean-out in the bottoms connected with a sewer. The sides of the hoppers slope 45 degrees for easy cleaning. Baffles are provided to aid in thorough mixing. The first baffle is standing; the second, hanging.

From the primary settling basins, the water passes into the coagulation basins proper, of which there are two, each 72 feet 3 inches long and 21 feet 6 inches wide. These are placed over the clear water basins. The 12-inch reinforced concrete floor has a slope of 3 inches in order to facilitate cleaning. At rated capacity of operation, the new plant will allow a detention and settling period of 6 hours.

Aluminum sulfate will be applied by dry feed machines, of which two are being installed, one of which will be kept in reserve.

From the coagulating basins, the water will pass to the filters. These are two in number, each 18 feet wide and 20 feet long. Each filter will be equipped with four wash-water troughs. These are of the usual type of elongated "U" of cast iron.

In the design of the filter bottoms, an effort has been made to avoid the use of any material subject to corrosion. The result is a rather unusual type of bottom.

The floor of the filter is composed of concrete, reinforced, and with openings the shape of inverted pyramids, having concave sides. At the bottoms of these inverted pyramids there are set into the concrete quarter-inch glass tubes, such as are used for boiler gauge glasses. The pyramids are 3 inches wide at the base and about 2 inches deep. The filter floor will be covered with an 8-mesh, 20-wire, bronze cloth, and on top of this will be placed the layers of gravel and sand forming the filter proper. The grading and depth of this has not yet been decided upon.

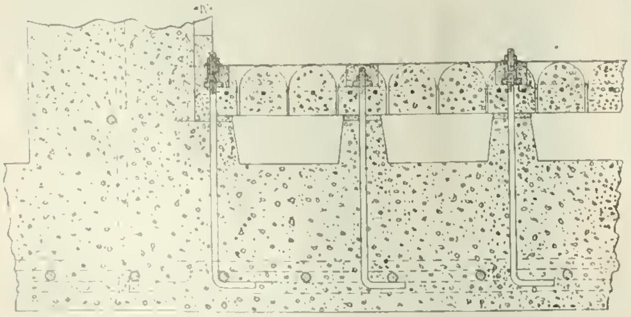
The filter floor is pre-cast of 1:2 cement mortar, in blocks three feet long and a foot wide. The glass tubes are cast in place at the time of casting the blocks. Under the floor proper of the filter is a sub-floor, made up of channels and ridges. The channels are 8 inches wide at the bottom, 4 inches deep, and 9 inches wide at the top. They are set on 12-inch centers, so that the filter floor blocks, which are 12 inches wide and 36 inches long, will just fit on the ridges between the channels. The glass tubes discharge the filtered water into these channels, which convey it into the clear water basins below.

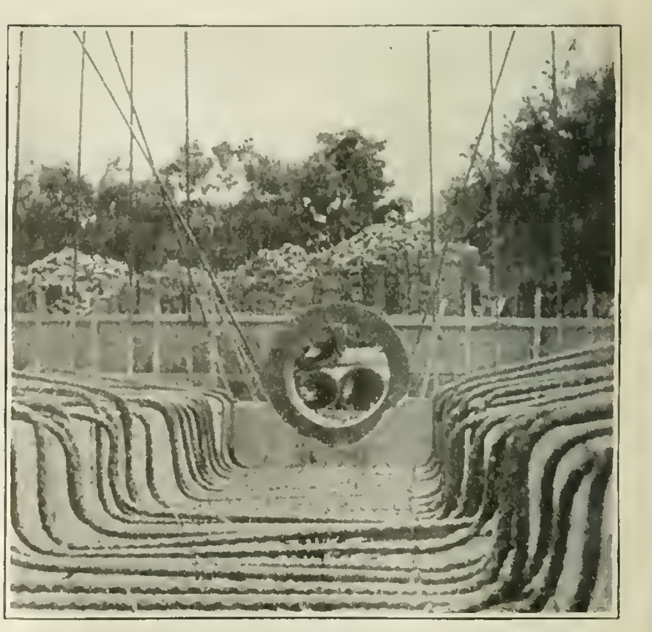
In the ridges iron bolts are cast at 12-inch intervals. These come up between the floor blocks and are used to fasten these down. Carrying out the idea of protection from corrosion, these bolts are covered with cement mortar, which is used to fill the groove in which they are located.

From the filters, the water will pass into the clear-water basins beneath, and from there will be pumped into the mains by direct-connected, electrically driven, centrifugal pumps. Pressure will be maintained by an elevated tank 110 feet high, having a capacity of 305,000 gallons. At present, the construction of this tank is held up because of a suit by a neighboring property owner, who has contended — and his contention has so far been upheld by the courts—that it will be a menace to his life and property, and that it would probably fall upon him.

Water for washing the filters is provided in a tank on top of the filter house, which will yield a large volume of water under low pressure.

The reinforcing throughout the building is very heavy. The walls of the first floor are reinforced with a double row of steel, inside and out. The vertical reinforcing is of ¾-inch square bars set on 6-inch centers, while the horizontal is also ¾-inch bars but set on 12-inch centers. The second


METHOD OF SETTING FLOOR SLABS OF FILTER


REINFORCEMENT OF FILTER TROUGH

floor walls have a single row of reinforcing, ¾-inch bars 6 inches on centers vertical and 12 inches on centers horizontal. The floor over the clear-water basin has a double row, top and bottom, of reinforcing. On the top, ½-inch square bars are spaced 12 inches on centers both ways; on the bottom ¾-inch bars are spaced 8 inches longitudinally and ½-inch square bars 7 inches on centers crosswise.

The concrete in the entire plant is mixed 1:2:4. Broken stone had to be shipped in from Columbia, S. C., but sand was found locally in the beds of small streams. Dominion portland cement was used. Waterproofing was used throughout.

All concrete was mixed with a Rex one-bag mixer. All concrete was placed by barrows. The floors were poured from runways mounted on four-legged horses. The walls were poured from barrows. When a horizontal joint was necessary, as at the end of a day's work, the concrete was "creased" to make a good joint, wetted in the morning, and flushed with a creamy mortar. No placing was done by chutes, but all concrete was delivered to a dumping bucket.

The Rex mixer, while rather small for the job, did excellent work. In one continuous stretch of four days and one hour—forty-one hours of work —70½ cubic yards of concrete were placed.

Excavation for the building was by wheeled scraper and hand. Labor-saving machinery was little used.

The plant was designed by W. M. Piatt, consulting engineer, of Durham, N. C., and F. W. Simons is resident engineer. Tucker & Laxton, of Charlotte, are the contractors, and J. P. Propst superintendent of construction. W. J. Alexander is city manager of Gastonia.

New Dam of Providence Water Works

Actual construction work has been going on for two or three months on a new dam known as the Kent dam for increasing the water supply of Providence, R. I., which will create a reservoir at Scituate. The total cost of this dam will probably approximate $5,000,000. It was planned in 1917 and the plans approved in July of the following year.

In April of this year the water supply board received permission to raise $4,000,000 for financing the construction and bids were opened on April 27. The only bidder under $4,000,000 was Winston & Co., of Kingston, N. Y., whose bid was $3,499,925, and this company received the contract on May 4. Since then a considerable amount of preliminary work has been done. It was found necessary to build a railroad from Jackson to the reservoir for bringing in plant and materials, and in addition the city let a contract to Louis Longhi & Bro., of Torrington, Conn., for $57,464 for building a road around the reservoir 1¾ miles long. The railroad was completed a few weeks ago and machinery and supplies carried over it and steam shovel work begun in July. The first monthly payment for construction work was made on August 15, amounting to $14,994.80.

Rahway's Water Situation

Like many other communities in New Jersey, Rahway is stirred up over the water situation, both the quantity and quality of the public supply being questioned. A committee was appointed to investigate and report upon the subject and many citizens expressed their opinions and various degrees of ignorance of the subject in the daily papers. Fortunately, the chairman of the committee, P. R. Forman, seems to possess a judicial mind too seldom found in the members of citizens' committees of this kind. His report, presented a short time ago, might well be studied carefully by other communities which are confronted by similar problems.

Mr. Forman says that the water can be criticized as to occasional bad tastes and odors and that it is not at all times clear. It is derived from the Rahway river, which passes through a number of communities and cities which contribute sewage and street washings to it, and this pollution, and especially that contributed by chemical plants and other works, is likely to increase. It is to be considered, however, that the supply will apparently be abundant for some years to come, that with such purification as it is now receiving it is safe from a health standpoint, "as has been proven by the health of the community and the best bacteriological tests that we have been able to have made"; the tastes and odors have been traced with reasonable accuracy to a source where the trouble can be removed without insurmountable expense.

If a better supply can be obtained, it then becomes a question as to the cost of this supply and whether the community wishes and is able to spend the necessary money for obtaining the more desirable supply. Rahway is a manufacturing city and makes no effort "to be attractive in appearance and appointments and thereby attract to itself the best class of residents. . . . The majority of its people are employed in various capacities in its factories or in plants in the neighboring communities. The result is that they have not been in a position, from a financial standpoint, to do those things that must be done if a city is to be one that will attract to itself the best class of residents. Therefore, our water calculations must be based on three very important factors:

1. It must be safe for the health of those using it.
2. It must be suitable for manufacturing purposes.
3. It must be within the spending ability of our taxpayers."

Mr. Forman adds that, in view of the fact that the present supply is safe, time can be taken for continuing investigations without the necessity for hurried decisions that may later prove to have been unwise.

In too many instances decisions on improvements of this kind result from hurried action following hysterical propaganda by certain citizens, but it is to be hoped that Rahway will take the advice condensed in the above statement and make a thorough study of the various phases of the problem before taking definite action.

Wisconsin State Highway Department Equipment

According to the Wisconsin State Department of Engineering report for the quarter ending July 1, 1921, the principal items of equipment of the Highway Division received since March 1, 1921, included fifty-two 3-ton Riker used trucks and two car loads of Riker spare parts. These parts are of very good selection and will be of great aid in placing the 52 Riker trucks in condition.

To date there have been received 36 used ten-ton Holt tractors, 30 of which are at work.

Thirty-three Anderson 3-ton, 4-wheel reversible trailers, equipped with 36 x 5 solid tires, have been received. A third allotment of T. N. T. amounting to 227,960 pounds, has been received. This was cartridged by the M. J. Connolly Company at five cents per pound; 156,125 pounds was reshipped upon its arrival to counties and contractors, the remaining 71,835 pounds is in storage at Arcadia.

The following is a list of the miscellaneous material received: 12,770 feet of suction and discharge hose, 2 inch; 12 log wagons; 10 gravel screens; 20 thirty-five H. P. four cylinder motors; 8 fifty H. P. four cylinder motors; 18 truck governors; 3 Buda track drills; 1 machine lathe; 76 crowbars; 68,000 No. 8 detonators; 6 log wagons; 68 rip saws; 5,400 round point D handle shovels; 393 square point D handle shovels; 455 long handled square point shovels; 500 spades; 2 car loads wire mesh, 78 inches wide, in rolls of 150 feet each, eleven gauge wire; 1 Ingersoll-Rand vacuum pump; 1 large air compressor with motor attached; 1 car load pipe fittings and electric motors. (In this car were ten motors ranging from 15 to 50 H. P.

To date there have been received from the Federal Government 545 trucks and cars. Twenty-six of these have been salvaged on account of their unserviceableness. Twenty-six five-ton Pierce Arrow trucks have been transferred to the State of Utah on account of the five-ton trucks being too heavy for service in Wisconsin. The 52 Riker trucks are being held and will not be placed in service this year. This is due to lack of shop facilities. An additional assignment of trucks is now before the counties who are taking a number of trucks. There are still 48 trucks that have not been completely overhauled. It is estimated that these trucks are fifty per cent overhauled.

The trucks in the State fleet have been moving rapidly of late both to counties and to contractors. The Madison shop is now assembling Fords for spare stock. It is calculated to assemble Fords cheaper than they can be purchased, as a number of parts have been received from the government, and on the parts that are purchased a 25 per cent discount is secured.

State Highway Construction Overhead

According to a statement of George Coleman, state highway commissioner, Norfolk, Va., the overhead expense of the Virginia Highway Department, including both engineering and administration costs, averages from 6½ to 6¾ per cent of the cost of construction, as compared to the percentages of 6¼ in Delaware and South Carolina, while that in North Carolina, owing to the recent reorganization preparatory to doing fifty million dollars' worth of work is at present about 10 per cent. In Pennsylvania it is about 9 per cent and in California 15.86. In the Federal Aid projects the percentage runs from 2 to 10 with an average of less than 4 per cent. The high amounts are largely due to conditions where heavy grading is required. In Virginia concrete and bituminous macadam roads in several counties, each of them costing from $100,000 to $300,000 each, have been constructed with a cost of overhead and engineering as low as 3 per cent.

Ideal Section of Lincoln Highway

That section of the Lincoln highway between Dyer and Schererville, Lake county, Ind., has been tentatively selected by the board of directors of the Lincoln Highway Association as the location for the ideal section to form an object lesson embodying the most advanced, modern highway specifications. Extensive investigations of the topography, drainage, soil conditions, costs and other engineering features have been made, and there is rapidly being completed a tentative plan for a development that is expected to surpass all existing rural highways in adequacy, permanency, and beauty. Specifications provide for a concrete pavement 40 feet wide and 10 inches thick with 5-foot shoulders, in the center of a 100-foot right of way. Drainage will be provided by underground tiles, and there will be no open ditches. The 25-foot right of way on each side of the roadway will be improved by a walk for pedestrians on one side. Lights will be provided for illumination at night and a prominent landscape architect is developing a plan to emphasize and improve the natural beauties of the terrain. It is hoped that the grading may be done this year and the paving in the spring of 1922.

Street Pavements in Pennsylvania

The 33 third-class cities of Pennsylvania contain 783.13 miles of paved highways, according to statistics obtained in connection with a survey made by the Bureau of Municipalities of the Pennsylvania Department of Internal Affairs. The largest mileage in any one city is 98.68 in Erie and the next largest is 84.31 in Harrisburg. Next in order is Altoona with 55.66 miles, followed by Wilkes-Barre with 52.88. The least mileage is 2.07 miles in Coatesville, closely approximated by Lock Haven with 2.18 miles.

In the kind of pavement used, brick leads, being the principal pavement used in Bradford, Carbondale, Connellsville, Corry, DuBois, Easton, Franklin, Lancaster, Lock Haven, McKeesport, Meadville, Monongahela, Newcastle, Oil City, Pittston, Uniontown and Williamsport, and one of the two or three principal kinds in Altoona, Hazelton, Johnstown, Reading and Titusville. Asphalt is the principal pavement used in Allentown, Erie, Harrisburg, Wilkes-Barre and York and one of the principal kinds in Altoona, Johnstown, Reading and Titusville. Amiesite is the principal pavement in Bethlehem and Coatesville, and one of the principal kinds in Hazelton. Bitulithic is one of the principal kinds in Altoona, filbertine in Chester, and wood block in Lebanon, Pottsville and Sharon.

Three of the cities, Erie, Harrisburg and Reading own asphalt repair plants.

All of the cities require the street car companies to pay a part of the paving costs on streets where their tracks are laid. In some cities the companies must pay for the pavement between tracks and tor two feet outside the rails, while in others the space outside the rails is confined to nine inches on each side. The majority of the cities use the foot front rule in making assessments ot cost of pavement.

Pavement Breaker for Street Trenching

Automatic gasoline driven machine with capacity for breaking 500 linear feet of 8-inch concrete pavement, or frozen clay 18 inches thick, and 6 feet wide, in one 8-hour day.

Cutting through the hard surface of streets and pavements to permit the excavation of trenches has been facilitated in Detroit by the construction and operation of two locomotive pavement breaking machines, designed for the Board of Water Commissioners, George H. Fenkell, superintendent, and largely designed by Henry Cousino, engineer of power machinery.

The 9 x 15-foot machine, 14 feet high, weighs 14,000 pounds, is mounted on a pair of short forward crawler tractors and two rear wheels. It carries a short structural steel tower over the tractors, with a transverse track across the top of the front face, on which travels the suspended leads of a 1,225-pound drop hammer operated through sprocket chains from a 15 h. p. gasoline engine mounted over the real axle.

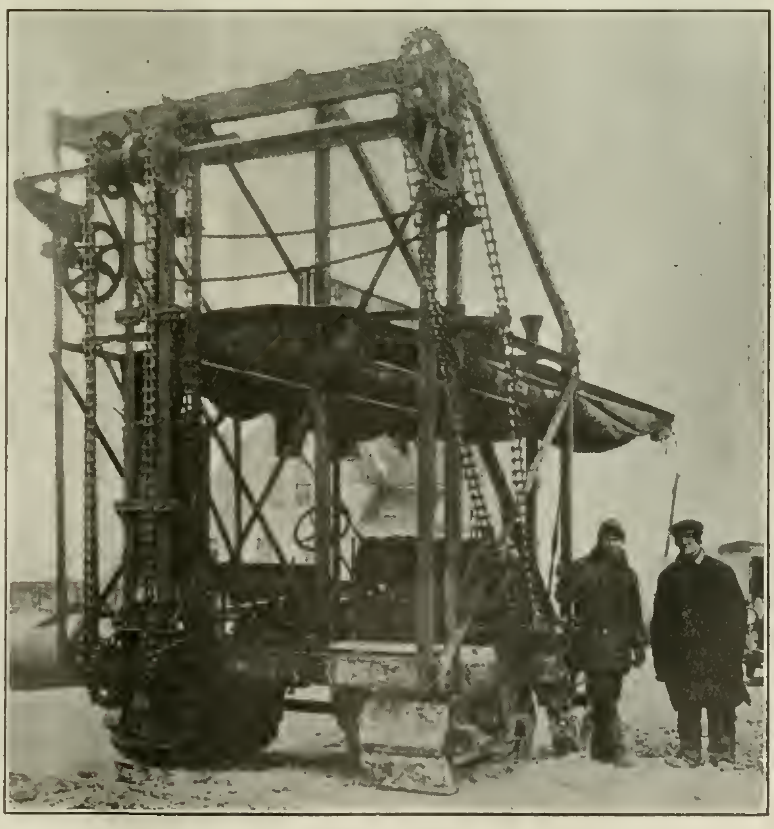
The hammer is fitted with a 9 x 14-inch removable hardened steel bit which has a 90-degree beveled cutting endge that may be set transversely or longitudinally. It has a hoisting speed of 76 feet per minute and strikes 14 blows per minute while the transverse motion of 35 feet per minute to a maximum distance of 6 feet, permits a shift of 21 inches between the blows

The hammer is lifted by hoisting chains that engage tilting spurs from the hammer that are tripped and allow the hammer to fall automatically when the spurs strike adjustable stops, which regulate the height of the fall, which is 7 feet maximum. The transverse motion of the hammer is controlled by a friction clutch and the breaking speed is approximately 15 inches per minute. The machine advances and moves from place to place under its own power at a maximum speed of about 1 mile per hour. It is operated by one man and a laborer following, and consumes 1¼ gallons of gasoline and ¼ pint of lubricating oil per hour.

The machine breaks a surface 6 feet wide and 500 feet long through 8-inch concrete in an 8-hour shift and can be operated on any kind of pavement but is more advantageously used for asphalt work in cold weather than in hot weather when the soft asphalt is liable to stick to the hammer. Last winter the two machines were used to break clay frozen to a depth of 18 inches and covered 500 linear feet of 6-foot trench in one 8-hour day. For wider trenches the machine had to make repeated trips.

Connecticut Taxes Gasoline

On September 1, Connecticut's new law went into effect taxing at 1 cent a gallon gasoline bought within the state for automobile use. Connecticut is a comparatively small state, and it will be possible for tourists to obtain sufficient gasoline in New York, Massachusetts or Rhode Island to carry them through the state and thus avoid the tax, although owners of automobiles residing in the state will with few exceptions find it impracticable to avoid the tax. Whether any large percentage of tourists will take the trouble neces-



PAVEMENT BREAKING MACHINE WITH CAPACITY FOR 3,000 SQUARE FEET IN 8 HOURS sary to save the 1 cent a gallon remains to be seen.

Concerning this tax the "Springfield Republican" says: "As a means of raising increased funds for road construction and maintenance the Connecticut law has obvious advantages. Certainly it is more fair than a flat increase of the registration fee, failing to differentiate between cars of different sizes and costs. As a smaller and lighter car consumes less gasoline per mile and at the same time contributes less to the wear of the roads, a tax upon gasoline consumption has much to recommend it."

Hell Gate Power House Tunnel and Wharf[*]

Concreting by tremie and in cofferdam formed by river wall and shore retaining wall. Construction of piers.

CONCRETING

The 1:2:4 concrete, of which about 25,000 yards were used for the tunnels and sea walls alone, was mixed in two traveling plants, each of which was installed on a 40 x 40-foot horizontal timber platform, mounted on wheels on a 28-foot gauge track, laid on a framed timber trestle about 450 feet long, parallel to the sea wall on the shore side. A stiff-leg wooden derrick with 65-foot boom was installed on each of two opposite diagonal corners of each platform, and on a third corner there was an elevated storage bin for aggregate. Near the middle of the river side of the platform there was a timber hoisting tower 60 feet high and a 1-yard Ransome concrete mixer, adjacent to which was the cement storage shed and a working platform. Cement, sand and gravel aggregate were received on scows, unloaded and deposited in storage by the derrick boom. The mixed aggregate was delivered from storage bins to the concrete mixer by gravity through the chute and the concrete was hoisted in the tower and spouted to the wall and tunnel through a huge chute made of two 30-foot and one 10-foot sections, suspended from a derrick boom.

Nearly all of the concrete for the sea wall was spouted to the 1-yard hopper of the 12-inch spiral riveted tremie pipe by which it was satisfactorily placed under water. The tremie and the small working platform enclosing the top of its hopper, were suspended from a derrick boom, the lower end of the tremie was placed on the rock bottom and the tremie pipe and hopper were filled with concrete nearly up to the top of the hopper. The tremie, controlled by guy lines, was then slightly raised and shifted longitudinally and transversely, required changes of elevation being indicated by red and green electric light signals, transmitted to the hoisting engine. About 15 yards of concrete were slowly deposited until the forms were filled to a depth of about 5 feet, after which the operations were more rapid until the form was completely filled on the same day that it was commenced.

PIER CONSTRUCTION

The river side of the wharf is supported on twelve 6 x 31-foot piers, which were concreted in open removable cofferdams. At the shore end of the piers the foundations for about 12 feet are on approximately horizontal rock surface, 20 feet below low tide elevation. From this surface the river bottom slopes steeply down to a point about 8 feet from the outer ends of the piers, where it is approximately horizontal at a depth of about 35 feet below low tide. At the shore end of the piers the cofferdams are made with detachable wooden panels, but in deeper water Lackawanna steel sheet piles were substituted for the panels to continue the side walls and form the river ends of the cofferdams.

The wooden sides of the cofferdams were full size panels made with solid courses of 6 x 12-inch timber, bolted to vertical outside 12-inch channels. They were assembled together by derrick boats and the panels were bolted together and the bearings on the rock were examined by divers who closed the openings under the cofferdam walls with short 3 x 12-inch vertical sheeting planks spiked on, and sand bags piled up on the exterior in the same manner for the sea wall forms. The derrick boat, securely moored in the proper position, then assembled the sheet piles forming the remainder of the cofferdam, and the lower ends of the sheet piles were banked with sand bags in the same way as for the wooden portion of the structure. The surface of the rock was examined by divers who cleaned it with a hydraulic jet and a centrifugal dredge pump in the same manner as for the sea wall foundation.

The piers requiring about 250 yards of concrete were poured by the tremie method, the concrete spouted from the hoisting tower to the tremie hopper as described for the sea wall.

After the piers had been concreted for 48 hours the bolts in the cofferdams were loosened by div-

SHEET PILE EXTENSIONS TO CRIB COFFERDAM FOR DOCK PIER ers, the forms panels were stripped from them, and the sheet piles pulled and both were reassembled for piers in advance.

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[*] Continued from page 215

SETTING THE INTAKE WALLS

Cylindrical holes were cut in the river side panels of the sea wall forms to receive the lower ends of the cast iron intake pipes, 57 inches in diameter outside and 54 inches inside. The pipes were made in three flange connected sections, 7, 10, and 10 feet long from the bottom up, and being heavy, were very carefully placed in position and adjusted by divers before the forms were concreted. The form openings around the lower ends of the pipes were carefully closed with 1-inch boards put on by divers and the concrete around the pipes was lowered in bags and carefully placed by divers until the pipes were imbedded up to low water level.

UNWATERING BEHIND THE SEA WALL

After the completion of the sea wall, heavy wooden bulkheads were installed in vertical recesses provided in it and in the shore retaining wall at the upstream and downstream ends, to enclose the space between it and the shore, and with the wall itself formed a cofferdam which was unwatered by a 12-inch centrifugal pump. The mottom inside the cofferdam was then excavated down

WALLS OF DISCHARGE TUNNEL COMPLETED, FORM BRACING NOT YET REMOVED

SEA WALL SERVING AS COFFERDAM. LOCATION OF DISCHARGE TUNNEL UNWATERED AND TUNNEL FLOOR PARTLY CONCRETED to sound hard rock by hand work. The surface was cleaned and entirely covered with a mass of concrete from 2 to 6 feet thick, the horizontal upper surface about 10 feet below low tide level forming the floor of the intake tunnels. On this floor wooden forms were built, in each of which there were assembled a pair of vertical cast iron discharge pipes 42 inches in diameter inside and 11 feet apart on centers. These, like the intake pipes, were made in three sections each, flange bolted together and thoroughly braced in position before the concrete was filled in around them, forming sections of the shore wall of the tunnel with intermediate spaces between them. After these sections were stripped, they were connected by form panels on the inner and outer faces and the spaces between them were concreted, completing the inside wall of the tunnel.

The river wall of the tunnel was then completed by concreting up to the battered face of the sea wall and making with the latter a solid mass 16 feet thick that was carried up to the tunnel roof, which is a wide solid reinforced slab 6 feet thick, which was concreted afterwards in a single operation, completing the tunnel and leveling up the top of the wall to the elevation of the wharf floor.

For this work the tremie was, of course, not required, and the concrete mixed on the traveler platforms was hoisted and spouted to position as required. The total amount of concrete in the wharf and tunnel, exclusive of the retaining wall, not here described, was about 20,000 yards.

The work was commenced March 17, 1920, the sea wall was completed January 1, 1921, and the entire concrete structure is now about 75 per cent finished. The present force is about 60 men and the maximum has been about 250 men.

The P. J. Carlin Company is the contractor for the wharf and tunnel, Post & McCord for the steel work and the U. S. Structural Company for the superstructure work. The power station was designed by Thomas E. Murray, Inc., and the entire construction work executed under the immediate supervision of George A. Hughes, civil engineer; John S. Kerins, resident engineer; and John H. Lawrence, engineering manager of that corporation.

Federal Government's Use of Highways

Mercer county, New Jersey, has made a claim on the United States War Department for $198,000, the estimated cost of repairs necessitated by the exceptionally heavy traffic of motor trains carrying war supplies. Burlington county also has claimed $400,000 damages for the same reason. The war department has declined to act favorably on the claims, based on the opinion that "the highways in question have been established and dedicated for the purpose of public use. There can be no question that the United States government is entitled at all times to the free and untrammeled use of public highways to as great an extent as private corporations or individuals."

"The establishment of cantonments and industrial plants was eagerly sought after by most communities by reason of the benefit derived from the money expended by both the government and individuals there employed, so even if extra repairs were made to the roads, the communities concerned were the gainers thereby."

Planning Board for Winston-Salem

The new planning board created for Winston-Salem appears, from local reports, to be possessed of practically nothing but advisory powers, and the benefits which it will be able to confer upon the community will therefore depend largely upon the influence which its personnel may have with the board of aldermen and the weight which its recommendations carry with that board. The planning board is to consist of five members, one being the commissioner of public works, one a member of the board of aldermen and the other three being citizens not identified with the city administration, serving for three years, one term expiring each year, the citizen members being appointed by the board.

The duties of the board are to be the recommendation of plans and maps for new streets, alleys, viaducts, bridges, subways, parkways, parks, playgrounds or any other public improvements; recommendations as to the preservation and care of historical landmarks; and recommendations to public authorities or to any corporation or individual in the city concerning the location of any building, structure, etc., to be erected, and concerning the platting and replatting of land. It will have power to appoint or employ clerical help and to employ such architects and engineers as are necessary to the performance of its functions.

American Public Health Association Semi-Centennial

The American Public Health Association is to hold a semi-centennial celebration in New York City November 8 to 18, which will consist not only of scientific sessions to be held November 14 to 18, but also of a "health institute" during the week previous, a banquet in honor of Dr. Stephen Smith, the founder and first president of the association, who is about to celebrate his hundredth birthday, and the publication of a volume entitled "Fifty Years of Public Health," which will be a history of public health up to the present date. In addition, there will be held in Grand Central Palace on November 14 to 19 a Public Health Exposition (announced as the "first annual") under the joint auspices of this association and the Department of Health of New York City, "to the end that the city and its people may derive the maximum benefits from this very important convention."

Detailed announcements, programs and information will be published later or may be had by addressing the secretary of the association at 370 7th avenue, New York City.

PUBLIC WORKS
Published Weekly
by
Public Works Journal Corporation

Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba..$3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

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Starting Up Grade

That a distinct impetus has been given to construction is shown by the fact that a number of the mills in the United States Steel Corporation that have long been closed have been put in operation and many new employees have been taken on in them within the last few days. Such action on the part of the greatest steel interest is sure to be followed by a large proportion of the other steel interests and will have an important psychological effect since it is generally acknowledged that the steel industry is an index of general national activity.

The increase of steel production is a sure sign of increased orders and that in turn means a greater amount of engineering construction to which the larger part of the finished steel products are applied.

Another vital element of engineering construction is Portland cement, which is used in almost every construction job and for few other purposes. According to the last report of the United States Geological Survey the production of cement in July was greater than in June, while the stock on hand was materially reduced from that of the previous month and the total production since January 1 was more than 97 per cent of that in the same period last year. Furthermore one of the greatest cement mills with a capacity of 1,000,000 barrels per year, reports a record production last month, in excess of the annual rate.

Reports from Boston, Pittsburgh, Detroit, Toledo, Chicago, Syracuse and Elmira state that many more workmen are being employed and that the applications for employment are less. In the Pittsburgh district there is a marked increase in freight shipments and it is said that in some quarters there is reason to believe that the lowest point in industrial depression has been passed.

It is probable that for the present there will be little important reduction in the cost of construction materials and as there is now plenty of labor that will be fully employed when industry and construction are under good headway, it is the part of wisdom to make plans for organization and equipment for construction work that may be commenced this season or prepared in advance for next season, or which with special care can be carried on during the winter, thus saving delays, loss from a rising market and greatly diminishing overhead and fixed charges.

Touring Typhoid

For a number of years it has been common for the health officials in most of our cities to expect a greater or less increase in the typhoid rate in the late summer and early fall, such cases having presumably been contracted chiefly by the drinking of impure water at vacation resorts, and being classified as "vacation typhoid." During the past few years the water supplies in the popular resorts of the more progressive states have been pretty well looked after and most of the cases of "vacation typhoid" probably have been caused by impure well water at farm houses and boarding houses which are so numerous that the state health authorities have found it impossible to give them all individual attention.

During the past two or three years the enormous increase in the amount of automobile touring has greatly augmented the danger of typhoid contracted on these pleasure trips. Not only are those touring through the country liable to drink from polluted wells or streams, but, in certain sections of the country especially, a great many of them camp out at points in more or less common use, generally on the outskirts of cities. Since in the majority of cases these camping places are under no supervision whatever, their condition from the point of view of sanitation soon becomes dangerous to campers and there is great probability that many of them may become centers of typhoid dissemination.

The United States Public Health Service is looking into this matter, paying especial attention to the national parks, endeavoring to make them safe and sanitary for the vast numbers who have recently taken to touring them. On May 15 the service sent its first sanitary engineers into Yellowstone, Mt. Ranier, Yosemite and Grand Canyon parks, while other engineers are being sent to the other parks as they become available. In the largest and most popular parks, such as Yellowstone, it will be necessary for a sanitarian to remain all summer. The work of the health service consists in examining and protecting health supplies, disposing of garbage and sewage, inspecting milk and food and the way they are handled, providing for camp policing and sanitation, and preventing malaria. Malaria carrying mosquitos have been found in Yosemite park and special efforts are being made to eradicate them there and prevent them from obtaining a foothold in other parks.

A number of cities, especially in the west, have provided special camping places near their boundaries where water and sanitary facilities are provided and which are under a more or less continuous supervision. From a health view if from no other, it is desirable that all such camping places be under strict supervision of some state, county or city authority.

The State Highway Department of Pennsylvania has received hundreds of inquiries relative to possible camping sites on the highways of that state and finds that few, if any, municipalities provide such sites. It is reported that there are no suitable locations for camping in the vicinity of Philadelphia, but the automobile club of that city is endeavoring to provide camp grounds on Roosevelt boulevard. On the Lincoln highway there are scores of camp sites along the Juniata river and there are numerous places between Philadelphia and Pittsburgh on this highway where private land owners permit tourists to occupy their grounds. A number of local motor clubs throughout the state have arranged for free camping sites, but so far as can be learned no municipalities of the state have charge of any of these sites, nor does it appear that there are any special precautions taken towards insuring sanitary conditions. Even in the notice sent out by the State Highway Department "it is urged upon all users of sites that they gather up waste paper and other debris upon leaving" but no warning is given of the danger of insanitary practices.

It would seem as though all state health departments should take action in this matter, posting signs at all places used either with or without permission by numbers of touring parties, giving instructions as to where safe water may be obtained, advising the boiling of doubtful water, and giving instructions for sanitary use of the grounds. In addition, they should arrange to in some way secure an enforcement of sanitary regulations relative to the use of camping sites, either directly through their own agents or through the nearest local boards of health. It would seem probable that funds for the payment of at least a considerable part of the cost of this oversight might be obtained by contributions by state or local motor clubs, since it is the motorists themselves who would chiefly be benefited by the enforcement of such sanitary regulations.

New England Water Works Association

Papers and Discussions Before the Fortieth Annual Convention

The fortieth annual convention of the New England Water Works Association was held at Bridgeport, Conn., on September 13 to 16 and was attended by about 150 active members, 100 associates and 160 guests. The program of papers was carried out as printed. The sessions were begun practically on time and, although there was the usual amount of discussion, sufficient time intervened between them to permit of the renewing of old acquaintances or other social gatherings, which is one of the most enjoyable and perhaps profitable features of these conventions.

The exhibit hall was well filled but not crowded with the customary exhibits of meters, brass goods, pipe and other materials entering into the construction and operation of water works plants.

Quite a considerable number of the members brought their wives and daughters with them and the entertainment of the ladies was well taken care of by the committee. The entertainment of the members included an automobile tour of the reservoirs of the city, a visit to the works of the Crane Co. and to the Bridgeport sewage treatment works, where two R. W. screens were in operation; also a picnic and shore dinner at the "Farms." Many of the members spent a large part of their time on the golf links of the Brooklawn Country Club; in fact, the days of the convention being unusually fine, the attendance of only 50 or 60 at most of the sessions was attributed to the presence of many of the members at the golf links.

Following the addresses of welcome and the business meeting on Tuesday afternoon was a description by S. P. Senior, president of the Bridgeport Hydraulic Co., of the water works by which that company supplies Bridgeport with water.

On Wednesday morning the report of the Committee on Standard Specifications for Water Meters, which was printed in the journal of the society for June, was adopted without discussion. Two papers on materials used in water works equipment, "Manganese Bronze for Valve Stems," by William R. Conard and "Monel Metal and Its

Suitability for Water Works Uses," by H. S. Arnold were read and a few questions answered by the authors. As to monel metal, it was stated by Mr. Arnold that monel castings cost about twice as much per pound as bronze, but its greater strength permitted the castings to be made somewhat lighter. It has been adopted for valves in a few cases, but probably more often for metal parts of sewers, sewage plants and other structures subjected to corrosion. It is used for valves for handling chlorine gas.

Following the paper, one of the members asked to be informed what experience others had had with leadite and other lead substitutes and several members responded. Mr. Van Gilder, engineer of the Atlantic City water department, gave numerous experiences with it, as did Mr. Diven. Both had had good success. Some of it at Atlantic City has been in use nineteen years and is still in perfect condition. When leadite joints leak, they are calked with lead wool or a lead "dutchman," Mr. Van Gilder stated, although one of the other members had not had success with this method. The secretary stated that he was arranging to have one session of the winter meeting of the society devoted to a discussion of this question.

On Wednesday afternoon Reeves J. Newsom, water commissioner of Lynn, Mass., read a paper entitled "The Economy of High Initial Cost and Extreme Care in Service Pipe Installation," in which he described the practice in Lynn in laying cement-lined service pipe. He had found that in such services the fittings, which were not lined, filled up with corrosion and recently it had been their practice to line all the fittings with lead. When a cement-lined pipe, carefully cut so as to preserve the square end of the lining, was screwed up against the lead, and the lead was reamed out to full bore if necessary, a practically continuous non-corrosive surface was obtained. Asked how he cleaned services which were stopped up with rust or deposits, he stated that the pipe was cleaned in the usual way but that deposits in the corporations were forced out in the following way: At the end of the service pipe in the cellar a brass ferrule was fastened and a wooden plug fitted into it snugly but not tight. This plug was set in the end of the ferrule and then given a sharp blow with a hammer. This resulted in a water percussion which usually blew the deposit out of the corporation into the main.

Samuel E. Killam, superintendent of the Metropolitan Water Works of Boston, described in a paper how that, during the war, some pipe delivered to the city had been stored in the yard and it was found a short time after that over large patches of the pipe the coal tar lining had entirely disappeared. The attention of the manufacturers was called to it and they stated their inability to offer any explanation. However, they took particular pains with future shipments and the trouble was not repeated. Reference was made to a boat load of pipe being carried to New Bedford which was sunk before reaching the city and later was raised, but by the end of two weeks in the salt water the coating had entirely disappeared. Some years ago the tar coating originally recommended by Angus Smith, and which was presumably the same as that now employed, was tested in salt water by French engineers and at the end of a year was found to be in practically perfect condition. The conclusion was drawn by one or two of the members that the coal tar coating now used was not the equal of that employed fifty years ago. The question being raised as to whether more effective specifications for the tar coating should not be embodied in those for pipe, Mr. Hazen stated that he had furnished to the committee of the society engaged in preparing pipe specifications, the specifications prepared by Professor Dudley for the Pennsylvania Railroad and used by Mr. Hazen, who understood the committee would recommend these specifications. Question having been raised as to the recoating of pipe, Mr. Hazen stated that the Spring Valley Water Co., of San Francisco, recoats its pipe in the yard and that Springfield, Mass., also has provisions in its yard for doing so. Cold dipping or painting appeared to be in general use for recoating pipe, and the fact was brought out that valves are painted by the manufacturers cold, usually with an asphaltum paint, and that this coating seems to last as well as that on the cast iron pipe.

"The Control of Water Waste by House to House Inspection" as practiced by the Bridgeport Hydraulic Co., was described by Gordon Z. Smith, chief inspector. Mr. Smith stated that only 20 per cent of the services in the city, and those the largest ones, were metered and these services paid about 50 per cent of the income. He presented calculations to show that, if metering should reduce the waste to the extent experienced in other cities, it would mean a saving to the Bridgeport company of about $35,000 a year, but that the actual cost of maintaining and reading meters and interest and depreciation on the same would amount to about $60,000, and that the company had therefore decided not to greatly extend the use of meters, for the present at least. This paper was followed by a general discussion on the advisability of using meters, which use was favored by most of the members as being the only fair method as well as being generally to the financial advantage of the company or department. Even though the actual reduction of waste did not amount to more than the cost of metering, it was often the case that enlargement of the supply, and of the pumping and purification plant when these were needed, and also of the distribution system, would be avoided or postponed by the use of meters and that the financial saving here might be very great.

In the evening W. G. Chace, of the Lock Joint Pipe Co., described the latest designs of reinforced concrete pipe as laid by that company, illustrating the paper by moving pictures showing the actual work of construction and of installation.

J. W. Ledoux gave some suggestions on the choice of kind of pipe for water works, stating that under some conditions, while the adoption of cast iron might be conservative, it was sometimes not the most economical and otherwise not desirable. He named some of the advantages of cement-lined pipe and devoted considerable time to the consideration of wood pipe. In discussing the use of wood pipe, some of the members stated that it was not sufficiently tight to make its use desirable where the pressure exceeded 30 or 40 pounds per square inch, and that it would deteriorate rapidly unless kept continually filled with water under pressure.

Following this, William J. Orchard read a paper entitled "The Chlorination of New England Water Supplies," giving a general review of the situation of chlorination in the New England states.

The Thursday morning session opened with a paper by C. W. Marsh, entitled "The Electrolytic Generation of Chlorine at Its Point of Application." He stated that formerly a suitable cell had not been discovered whereby current could be applied to the creation of chlorine economically in the small quantities required by most water works plants; but that he had designed a cell much more efficient than had heretofore been available and in fact that these small cells would produce chlorine at a cost less than that of production by the machines of the large manufacturers. Not only this, but the cost of transportation, containers, etc., was avoided and, still more important, the gas was supplied at atmospheric pressure or slightly less than atmospheric and that therefore there was no danger of escape of the gas from the apparatus. The operation of the apparatus was not at all complicated or difficult nor did it require much attention. The amount of gas did not need to be measured directly but was always directly proportional to the amount of current used, and that by varying the current, the gas could be regulated to the needs of the water being treated. He estimated the cost per ton of chlorine to be $44 for salt, $10 for interest and depreciation, $50 for power (at 2 cents per k. w.), or a total of $104. The labor, he claimed, would be no greater than that required to handle liquid chlorine apparatus and less than that required for hypochlorite. In discussing the paper, Frank W. Green, superintendent of the Little Falls, N. J., filter plant, stated that chlorine manufactured by them for use at the plant cost 1½ cents a pound in addition to the current, which was obtained free by water power at the plant. He stated that four water works plants now manufactured their own chlorine.

The paper entitled "The Typhoid Fever Epidemic at Salem, Ohio," by W. H. Dittoe, was read by Morris Knowles in the absence of Mr. Dittoe. Mr. Knowles had prepared a written discussion of the paper describing the changes that had been made in the Salem plant subsequent to the investigation and following the recommendations of the health board, his firm having been engaged to perform this work. In general it was stated that the epidemic, which was an unusually severe one as to number of cases but with an unusually low fatality rate, was undoubtedly caused by leakage in a gravity line bringing water from wells to the reservoir, which line was paralleled by a sewer supposed to receive only storm water but which was found to receive the house sewage from several residences, one of which had contained a typhoid patient.

Harrison P. Eddy, of the firm of Metcalf & Eddy, read a paper entitled "The Significance of Hydrogen Ion Concentration in Water Purification," in which he endeavored to present in popular language the present knowledge or belief of investigators of this subject and recommended the use of determination of hydrogen ion concentration in regulating the application of chemicals in water purification. This paper was discussed by Frank W. Green and Stephen DeM. Gage.

In the afternoon, S. P. Senior, in place of reading a paper, presented to the society the question: "Can High-Value Watershed Lands Be Put to Profitable Use?"—a question for which his company was endeavoring to find an answer. Quite a number of members expressed opinions and suggestions, although Mr. Senior reminded them that what he specially desired was statements of actual experience. The land referred to was worth $200 or $300 per acre and seemed too valuable to allow it to grow up in weeds or to use it merely for the growing of white pine or other trees. Experiments had been made by his company in growing grass, which required little labor. Potatoes had been raised but at a loss. The company is now raising apple and peach trees on the land. Mr. Diven thought hay would probably be best for the water supply, since plowing the land would be apt to give muddy water after rains. He suggested that alfalfa might give larger returns if the soil was suitable, stating that for hay the soil would probably have to be plowed over at five or six-year intervals, but only about once in ten years for alfalfa.

Mr. Hazen stated that the Spring Valley Water Co., of San Francisco, owned about 100,000 acres of land and had put this in charge of an agricultural department, which drained the land or made other necessary preparations and leased it to farmers on short leases and with restrictions as to what they could do with the land. Some of it was used for crops, some for dairy farming, etc. One of the restrictions was that no land within a given distance of any reservoir could be plowed. Quite a little of it was used for sheep grazing, this being found to be less injurious to the water than cattle grazing. T. L. Bristol, president of the Ansonia Water Co., said that that company had tried raising chestnut trees and white pines, but both of these had been carried off by blight and that they were now trying red pine. The company had tried raising sheep on shares and had lost $3,500 thereby. Alfalfa had been tried but had been winter-killed. They were now growing grass on a considerable part of the area and also cider apples. M. N. Baker recommended Scotch pine from his personal experience. X. H. Goodnough stated that orchards had not been tried in Massachusetts, but that pine growing was quite general and was estimated to yield $7 per acre per year when once established. In raising sheep he believed that the estimate could be used of three sheep per acre. Two or three of the members suggested that if fruit were grown most of it would be stolen, while others stated that if fruit were grown in quantity, which was the only practicable way, one man could readily guard it during the season when it would be in danger of theft. Rudolph Hering suggested that instead of endeavoring to take over all the land on a watershed and either let it grow wild or be put to some use much less productive than formerly, it might be best to permit the farmers to continue to occupy the land and to guard against ny danger from pollution thereby by filtration and chlorination.

Following this, Allen Hazen discussed in a brief and admirably condensed paper "The Economics of the Several Lines of Defense in the Protection of Water Supplies," these several lines being the removal of possible sources of pollution from the watershed, the taking of precautions where such removal was not possible, the storing, filtration and chlorination of the water. While each of these, if performing its function perfectly and without interruption, might be relied upon to produce a fairly safe water, interruptions of service and specially lapses in efficiency were not only possible but probable and it was the duty of superintendents to adopt all of them to a greater or less extent in order that no practicable safeguard of the health of the people might be omitted. In the discussion several other safeguards called for by special conditions were referred to, such as the preventing of pollution by connecting private and public supplies through factory fire protection installations, special provisions called for by rapid growth of automobile touring, camping, etc.

In the evening a very interesting paper was read by George C. Whipple, in which he gave a comprehensive "Appraisal of the Quality of Water Supplies in Massachusetts," giving both general summaries and tabulated details.

At the last session, on Friday morning, J. Frederick Jackson read a paper on "The Pollution of Streams Affecting Industrial Uses," and Clarence E. Carter and Walter F. Abbott one describing "The Repairs to the Standpipe at Bath, Me.," of which there was little discussion.

Construction Questions Answered

Suggestions as to methods, "wrinkles"and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Drive Small Earth Tunnels

Hardly any kind of construction work is as irregular and uncertain as tunneling may be. It is work that can be easy or difficult, simple or complex, cheap or costly, safe or dangerous, rapid or slow, according to conditions, some of which are uncertain or beyond control and may be unexpected and completely change the character of the work at short notice.

Generally the difficulties of tunneling increase very rapidly with the width and much less rapidly with the length and depth of the excavation. The most important elements are the size of cross section; the character of the material penetrated; and the amount of water and gas encountered. When all conditions are favorable the work may be executed with very simple methods and appliances and when they are unfavorable elaborate and expensive plants may be necessary and great skill and experience and heavy expense be required to do the work.

The conditions and methods of executing the work in rock tunneling are so different from those required in earth tunneling, and as most of the small jobs that may be from time to time encountered by the general contractor are of the latter variety, earth tunnels only will be considered in this discussion. If any of the dimensions of the tunnels are very large, or if it is not known that conditions are favorable or if great accuracy or special requirements are necessary, the work should be done under the direction of competent engineers, by experienced specialists who are provided with the necessary plant and with abundant resources for slow and costly work. Small short tunnels driven through solid dry earth under favorable conditions can be safely executed by comparatively inexperienced reliable workmen and capable superintendents employing well-known methods and appliances and a moderate installation of ordinary equipment.

EXPLORATIONS AND PREPARATIONS

Except for lengths of only a few feet or yards, as where it is necessary to pass through narrow embankments or under streets or roads, and the conditions can be determined by inspection, and where little opportunity is generally possible for choice or for modifications, the first operation should be a careful examination and survey of the site and a subterranean exploration along the alignment to determine as accurately as possible the geological and hydrographic conditions that may be judged to some extent by the topography. Soundings should be taken along the alignment to show the character of the underlying strata and may be made by a sectional steel rod driven with sledges; by sinking small test pits; and by wash borings made with double pipes driven to the required depth and provided with a water jet that will wash up samples of the soil encountered.

Records of previous local excavations, if there are any, indications observed in nearby railroad cuts, and inspection by a local geologist may often be available for further information of the probable character of the soil. It is especially important to know if the tunnel will be through or below a water-bearing stratum, such as sand or gravel at an elevation below the surface of adjacent streams or lakes or below the level of ground water as indicated by wells in the vicinity.

Large quantities of ground water encountered in the tunnel or shafts are very troublesome and cause great delay, danger and expense.

The soils most easily and safely tunneled are hard, dry earth, clay, dry, coarse, compacted sand, a mixture of clay or sand and gravel or any firm, hard, uniform soil.

The most difficult and dangerous materials are quicksand, silt, soft mud, fine water-bearing sand, sand containing large boulders, sand or earth with pockets of quicksand, gravel or large boulders, or any very wet, soft material, and material containing any obstructions or intersected by seams or fissures containing water. Tunneling where the upper or lower part of the excavation is in earth and the remainder in rock or hardpan is also difficult.

SURFACE SETTLEMENT

Especial difficulty and expense are involved if it is necessary to prevent the surface settlement of adjacent ground, which is always uncertain and almost impossible near the surface in very wet, soft ground. It is generally an important consideration in tunneling under streets or buildings or other foundations. In such cases the tunnel driving itself may be easy and simple, but the displacement and even the drainage of the soil, may cause great danger or damage to adjacent structures. In such cases the tunnels must be driven with great skill and often it is necessary to use methods and precautions that would not be required for the same tunnel driven in remote places, or it may be necessary to safeguard and underpin the adjacent structures before tunneling is commenced.

COMPARATIVE COST OF TRENCHING

The excavation of a certain yardage from the tunnel is always likely to be several times as costly as the excavation of the same amount of material in the open, and it is therefore desirable, other things being equal, to avoid tunneling when there is a choice of other methods, so that often when the final structure is necessarily a tunnel it may be built in the open and afterwards filled in to act as a tunnel.

Generally speaking, sewer pipes, water mains and other conduits can be laid or built cheaper in open trenches than in tunnels where the excavation is in earth and there is plenty of room for handling it and the depth is not greater than 20 or 30 feet. Sometimes, however, it is impossible to open from the surface of the ground as in the case of city streets where traffic must be uninterrupted and tunneling is unavoidable. In very treacherous ground if there are no serious obstructions it is often cheaper and safer to support the sides and roof of a tunnel to maintain the banks of a trench that might be preferable to a tunnel in good soil.

Trench construction is also advantageous in that it can often be prosecuted for long distances or for the entire length simultaneously if necessary, thus permitting the work to be done with great rapidity, and with a correspondingly large force and reduced overhead, while tunnels can often be driven only from one or both portals, or if driven from intermediate points also involve considerable time and expense and equipment for the working shafts, thus adding considerably to the time and cost.

PIPE TUNNELS

Where it is necessary to provide for the installation of sewer, water, gas pipes, culverts and other conduits or small steel culverts and it is not required that they should be accessible for inspection or repairs after installation, a tunnel no larger than the diameter of the pipe may suffice, but if the pipe is only two or three feet in diameter its dimensions are too small for a man to enter it, and work to advantage, and if the tunnel is driven by hand excavation it must be made considerably larger, about 6 x 4 feet being the ordinary, and 4 x 4 feet the extreme minimum of its dimensions. Such tunnels generally require lining or timbering and involve unfavorable excavation of a much larger amount of material than is required for the pipe displacement.

When the length of such tunnels does not exceed 100 or 200 feet they may often be made by forcing the permanent pipe from one end as described in the article on "Installing Pipes Through Railroad Embankments," published October 9, 1920. This method consists substantially of driving the pipe horizontally by powerful jacks operated at the rear end where successive sections of the pipe are added as the forward portion advances. Great care must be taken to preserve the alignment of the pipe and unless the pipe is of very small diameter the progress may be facilitated by some simple mechanical device for excavating at the forward end. If the pipe is two feet or more in diameter it will be possible for a man to enter and remove obstructions at the forward end where the work is very difficult and laborious.

Operations of this sort are likely to be much easier in very soft, wet ground and may be carried on from both ends to the center or even to intermediate shafts although in the latter case it would probably be necessary to operate continually with a single party in one direction only so as to be certain of continuous alignment.

DRIFTING METHODS

Tunnels with a wide cross section are generally constructed by several successive operations, the first being to drive one or more very small tunnels, parallel to the axis of the finished tunnel and within the circumference of its cross section. These advance tunnels are called drifts and from them transverse excavations are made until the entire cross section of the finished tunnel is excavated. Excavation in the drifts which are seldom more than 7 feet high or wide is much simpler and safer than in large cross sections, although under favorable conditions in good reliable ground the heading of a cross section up to 10 or 12 feet in diameter may be excavated at a single operation; usually, however, under favorable conditions the upper portion will be excavated first and the lower portion, then called a bench, excavated later on.

In ordinary ground the drifts should be high enough and wide enough for two men to work comfortably at the heading, which can be very satisfactorily done with 6 x 6-foot cross sections, dimensions which may be materially reduced if only one man works in it. The advantage of minimum cross section is the smaller amount of material handled and the decreased danger from falling roof. If the ground is treacherous it is very much easier to support the roof for a narrow than for a wide strip and the timbering for a 4-foot width is much lighter, cheaper and easier handled than for an 8-foot width.

For a width of more than 6 feet in bad ground much more complicated excavation and timbering methods are needed. It will generally require the service of experts. If there is reason to anticipate encountering much ground water, it is desirable to drive the tunnel on an upgrade if possible so that it will automatically drain itself, otherwise it will be necessary to provide pumping facilities which may require to be very large in order to keep the tunnel dry enough to work in.

EXCAVATION AND MUCKING

For good clay, hard earth or other satisfactory material a small drift can be excavated with picks, shovels and mattocks, casting the spoil directly into very small dump cars or wheelbarrows or throwing it behind the miners on the floor of the tunnel where it is loaded and removed by the muckers.

Wheelbarrows should only be used for very short distances and should then be provided with plank runways. Otherwise dump cars should be run on industrial tracks. If the tunnel is driven on up-grade the loaded cars can be handled by gravity and the empties pushed back by hand, or in larger drifts may be hauled by mules, which are much superior to horses for this kind of work.

Dump cars may also be hauled by stationary hoisting engines located at the entrance to the tunnel. Engines especially suited for such purposes have been designed to operate with compressed air that is so often available in such circumstances and if not gasoline engines or electric motors may easily be installed. Although the engines are most useful in hauling the loaded cars, it is also easy to anchor a snatch block at the heading and by the use of an endless rope from the drum passed through it, or two separate ropes, to haul the car in both directions by the use of the engine.

TIMBERING

In clay or other good sound earth it is sometimes practicable to excavate two or three feet or even more without artificial support for the roof, but the timbering should be provided in advance and maintained as close as possible to the miners, even though the conditions are apparently not threatening. In good soil it may be sufficient to support the roof with transverse cap timbers across the width of the heading, supported at each end on a vertical post mounted on a longitudinal sill or set on blocks or wedges according to conditions. The caps and vertical posts should have square ends and be cut to uniform length before delivery in the tunnel, and should be carefully wedged to solid bearing. Under specially good conditions they may not cover the whole roof, but generally the entire roof should be supported by them or by longitudinal boards laid close together across the full width to prevent the fall of any loosened material. If any cavities exist above these boards, they should be filled solid with clay or other material as soon as discovered. The caps and posts should be made of a minimum size of 6 x 6-inch timber, increased to 12 x 12 inches according as the conditions become less favorable. The bents are ordinarily from 2 to 4 feet or at the most 6 feet, apart on centers and under unfavorable conditions may be set close together so as to form a solid mass of timbers.

When the tunnel has a permanent lining, usually of concrete, it may sometimes replace the temporary timbering or, as is often the case, encloses it, retaining the timber after its original purpose has been fulfilled. If the timber is removed it is generally apt to be done piecemeal with great precautions and extreme care to fill the spaces quickly and thoroughly with concrete and prevent any possibility of movement commencing in the earth roof.

In some cases it has been found economical and satisfactory to line a circular tunnel permanently as fast as driven, with segmental wooden blocks, serving at first instead of preliminary timbering, and providing the final lining as well.

Klamath River Power Development

The California-Oregon Power Company plans to construct one or two large dams and develop 94,000 h. p. on a 10-mile length of the Klamath river, Klamath county, Oregon, and has filed application to the Federal Power Commission for permission to construct the work.

$220,972,000 August Building Operations

According to the F. W. Dodge Co.'s review, building contracts awarded during August, 1921, in the 27 northeastern states amounted to $220,972,000, of which $44,797,000 was for public works and utilities. The total volume of contracts let in this territory for the first eight months of this year is 10 per cent greater than the average for the corresponding period in the last five years. The territory reported on is divided into New England, New York state and Northern New Jersey, Middle Atlantic states, Pittsburgh, Central West and Northwest districts, for which the biggest amount reported was in the New York State and Northern New Jersey district where $61,010,000 was reported, an increase of 11 per cent over July. The smallest amount was in the Northwest district, $8,344,000, a decrease of 25 per cent from July.

Recent Legal Decisions

WATER COMPANIES CANNOT BE COMPELLED TO CONTRACT WITH TENANTS WITHOUT POWER TO CUT OFF SUPPLY OF DELINQUENT TENANT SEPARATELY

In a suit by the owner and tenants of several double tenement houses against a water company to restrain it from refusing to supply water to the tenants unless the owner would pay or guarantee to pay the usual charges for water supplied to buildings, the New Jersey Court of Chancery, Millville Improvement Co. v. Millville Water Co., 113 Atl. 516, denied the relief granted for the following reason. In the absence of statutory regulation to the contrary, it is the duty of a water company to lay water mains and all laterals, fixtures and connections in such manner that connections may be made with properties at the boundary lines between streets and alleys and private lots. It is not the duty and privilege of a water company to enter upon private property in the construction of its system beyond that boundary line, and it is not the duty or right of a citizen to lay pipes in the street or beyond the boundary referred to. Accordingly the owners and tenants of a building must accept entire responsibility for the suitable equipment of such buildings to receive reasonable service. Where the equipment of buildings of the class of office buildings or apartment houses makes no provision for the supply of water to the several offices or apartments except by a supply to the entire building as one unit, it is obviously impracticable for the water company to contract with the tenants of the several offices or apartments, unless provision exists to control the supply to each office or apartment. In the premises in question each double building was supplied by one service pipe in such manner that in order to supply one half of either building with water, water must also be supplied to the other half, since no stopcock or shut-off was provided to enable one half of the building to be separately supplied. Should any tenant for any cause determine to discontinue contractual service or seek free service or become delinquent, in order to serve the remaining tenant the water company would be compelled to continue to supply both tenants.

CITY HELD WITHOUT ACTUAL OR CONSTRUCTIVE NOTICE OF DANGEROUS CONDITION OF HIGHWAY FROM OILING

In an action by the owner of an automobile against a city and an oil company, for injuries to the plaintiff's car caused by its skidding into another car on a tar or oil covered highway of the city, it appeared that the oil was put on the road between 3 and 4 o'clock in the afternoon of July 30, 1918, and that the accident occurred between 8 and 9 o'clock of the same evening. The city did not have actual notice of any dangerous condition, and the New York Appellate Division held that the time was too short between the two events to hold it had constructive notice. On appeal by the city from a judgment for the plaintiff, the judgment was reversed and a new trial granted.—Pemberton v. City of Albany, 188 N. Y. Supp. 245.

STATUTORY REQUIREMENT AS TO FREE WATER SUPPLY BY MUNICIPALITY TO CHARITABLE HOSPITAL HELD DISCRIMINATORY

The Ohio Supreme Court holds, Village of Euclid v. Camp Wise Association, 131 N. E. 349, that by reason of the adoption of section 4, article XVIII, of the Constitution, in 1912, municipalities may acquire, construct, own, lease and operate water works free from any restrictions imposed by sections 3963 and 14769, General Code. It is also held that the obligation imposed upon municipalities having water works constructed prior to 1912 to furnish free service to charitable institutions operates as a discrimination against them and in favor of municipalities constructing water works after 1912, and therefore sections 3963 and 14769, General Code, in so far as they require free service to charitable institutions, are in conflict with section 26, article II, of the Constitution of Ohio, requiring laws of a general nature to have uniform operation throughout the state, and therefore inoperative.

DELAY IN PERFORMING AGREEMENT TO IMPROVE PROPERTY WILL NOT WARRANT CANCELLATION

The Ohio Supreme Court holds, City of Cleveland v. Herron, 131 N. E. 489, that where a conveyance of real estate for park and boulevard purposes is made to and accepted by a municipality, the stated consideration whereof was the sum of $3,000, which was paid, and the promise of the municipal authorities to improve said tract in the respects recited in the deed, "all of which shall be done as regards both manner and material pursuant to the direction and discretion of the board of public service . . . as rapidly as possible," and pursuant thereto a large sum of money is thereafter expended, the proposed improvement not being at any time abandoned, the grantor will not be awarded a decree of cancellation and rescission of the conveyance for delay in the prosecution and completion of such improvement, particularly where no ground of forfeiture is stated in the conveyance.

MUNICIPAL WARRANT PRIMA FACIE EVIDENCE OF THE VALIDITY OF THE DEBT

Following City of Sulphur v. State, 62 Okla. 312, the Oklahoma Supreme Court holds, Hamilton Township v. Underwood, 198 Pac. 300, that a municipal warrant is prima facie evidence of the validity of the claim for which it was issued, and if in an action instituted by the owner and holder thereof the municipality asserts as a defense a violation of some constitutional or statutory provision, the burden of proof is upon the municipality to clearly establish by competent evidence that at the time the debt was created for which the warrants were issued, the governing body of the municipality violated the provision of the Constitution or section of the statute relied upon.

NEWS OF THE SOCIETIES

Sept. 26-30 — ILLUMINATING ENGINEERING SOCIETY. Rochester, N. Y. Illuminating Engineering Society, Chicago Section, Chicago with National.

Sept. 26-30 — NATIONAL SAFETY COUNCIL. Boston, Mass.

Sept. 27-30—LEAGUE OF CALIFORNIA MUNICIPALITIES. Annual convention. Santa Monica, Cal.

Sept. 28 (10 Days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Sept. 23-Oct. 9—NATIONAL CONGRESS OF ENGINEERS. Buenos Aires.

Sept. 29-Oct. 1 — PENNSYLVANIA STATE ASSOCIATION OF COUNTY COMMISSIONERS. Annual convention. Harrisburg, Pa. Secretary, L. C. Norris, Clearfield, Pa.

Sept. 29-Oct. 1—AMERICAN ELECTROCHEMICAL SOCIETY. Lake Placid, N. Y.

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventth annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 3-7 — AMERICAN ELECTRIC RAILWAY ASSOCIATION. Atlantic City, N. J.

Oct. 5-7 — SOCIETY OF INDUSTRIAL ENGINEERS, National convention. Springfield, Mass.

Oct. 8—BROOKLYN ENGINEERS' CLUB. Dinner. Chamber of Commerce.

Oct. 11-14 — INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 11-14—AMERICAN ASSOCIATION OF PORT AUTHORITIES. Annual meeting. Seattle, Wash. Secretary, M. P. Fennell, Jr., 57 Common St., Montreal, Canada.

Oct. 12-14 — LEAGUE OF KANSAS MUNICIPALITIES. Annual convention. Lawrence, Kans. Secretary, John G. Stutz, University of Kansas.

Oct. 20-21 — CITY PAVING CONFERENCE. Engineers Club of Philadelphia, 1317 Spruce St., Philadelphia. H. E. Hopkins.

Oct. 20-21—OHIO STATE CONFERENCE ON CITY PLANNING. Annual conference. Columbus, Ohio. Secretary-treasurer — Charlotte Rumbold, Chamber of Commerce Building, Cleveland.

Oct. 24-28 — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore. Md. Secretary. Charles Carroll Brown, St. Petersburg, Fla.

Oct. 31-Nov. 5 — NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-16—CITY MANAGERS' ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual **meeting. New York City.**

Nov. 16-18 — NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

Nov. 17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Society of Naval Architects and Marine Engineers. New York.

Nov. 17-18—SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS. New York.

Dec., 22-23—KANSAS ENGINEERING SOCIETY. Hutchinson, Kan.

INTERNATIONAL ENGINEERS' DINNER

A notable dinner of much professional significance is to be held at the Engineers' Club, New York, October 10th, to formally celebrate the home coming of the mission of distinguished American engineers who went abroad to confer the John Fritz Medal upon Sir Robert Hadfield of London and Eugene Schneider of Paris. Besides the twelve members of the deputation, which represented the John Fritz Medal Board, there will be present members of the British and French societies by which they were received, together with the library board of the Engineering Societies and the engineers club, the trustees of the United Engineering Society, the officers of the Federated American Engineering, the chairmen of the executive board of the engineering foundation, the American Institute of Mining and Metallurgical Engineers, distinguished members of the four national American engineering societies, representatives of the British Institute of Civil Engineers, Institution of Mechanical Engineers, Institution of Mining Engineers, Institution of Mining and Metallurgy, Iron and Steel Institute, Institution of Electrical Engineers, and the Royal Society of London. France will be represented by the La Societe des Ingenieurs Civils de France.

Invitations have also been extended to Herbert Hoover, Secretary of Commerce, and Charles E. Hughes, Secretary of State, and other eminent American engineers and public men. It is expected that hundreds of civil, mechanical, mining and technical engineers from all parts of the United States will also be present.

Engineers on both sides of the Atlantic are engaged in intensive organization, and it is proposed to establish a new international contact which shall promote concert among the English speaking countries and advance the science of engineering and work along conservative lines for the establishment of international peace.

LOUISIANA ENGINEERING SOCIETY

The first meeting of the fall season was held September 12. Walter Parker presented a paper entitled "The Economic Value of the Industrial Canal."

The following resolution, offered by Mr. Lawes at the June meeting, was taken up for second reading:

Whereas, An ordinance has been passed by the Constitutional Convention and will become a part of the Constitution of the State providing for a State Board of Health to be composed of a President and eight members, five of whom shall be from the medical profession and three from such callings as the Legislature may designate, and,

Whereas, It is becoming more and more generally recognized that the Engineer is, by training and experience, particularly fitted to solve many of the problems, and to direct many of the activities of modern health work, particularly those phases which deal with community sanitation and control of insect-borne diseases, as is evidenced by the fact that the Legislatures of a number of states are requiring the appointment of Engineers as members of such Boards, therefore,

Be it Resolved, By the Louisiana Engineering Society that it heartily favors the appointment of an Engineer, fitted by training and practice to membership on the State Board of Health, and

Be it further Resolved, That the Society gives its unqualified endorsement to having a qualified Engineer appointed as a member of the State Board of Health, and expressly requests the Legislature at its next meeting to provide for such appointment.

PERSONALS

Sinks, Frank F., has opened an office in Seattle, Wash., for the practise of industrial and structural engineering.

Anderson, H. F., has been appointed road engineer of Mecosta county, Mich.

Dr. Miller R. Hutchison was elected president of an organization to investigate and develop inventions with offices in New York City.

Murray & Flood has been recently organized and has offices in New York.

M. M. Wyckoff has organized the Wyckoff Engineering Corp., New York City. They will engage in the general practise of engineering and contracting.

R. W. Downie has been appointed tester of building materials for the Welland Ship Canal with laboratories and office at Merritton, Ont.

Chas. M. Binford has opened an office in Beckley, W. Va. Here he will specialize in examinations and reports of coal lands and reports of coal lands and properties, the design and construction of coal plants, the improvement of existing plants to increase their capacity, town planning and building, suburban development and supervision of construction.

Vaughan-Lloyd, W. E., has been elected by the board of aldermen as director of parks and playgrounds of Winston-Salem, N. C.

Glasgow, L. J., has been re-elected sanitary officer of Winston-Salem, N. C.

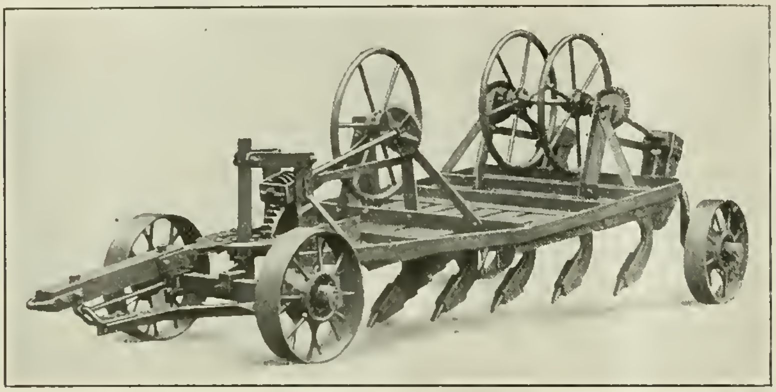
Atherton, Mayor A. of Newark, O., was removed from office September 10th by Goernor Harry L. Davis on charges of gross neglect by the Newark Law and Order League.

Borden, George W., assistant state highway engineer of Nevada, has been named acting state highway engineer to succeed C. C. Cottrell, resigned.

Conner, C. V., formerly with the Delaware state highway department, has been appointedl assistant engineer on th design and general field inspection of bridges and hard surface pavements with the North Carolina Highway Commission.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



SCARIFIER WITH TEETH IN RAISED POSITION

THE KILLIFER SCARIFIER

This machine, manufactured by The Good Roads Machinery Co., has been tested on all kinds of work, is claimed to be economical, convenient and serviceable for tearing up any kind of roadway that can be handled by any type of scarifier. It is designed to overcome the faults of other scarifiers that have a heavy cast iron frame mounted on small wheels, equipped with picks forced into the ground by screws and the weight of the frame and thus subject to disadvantages of great weight to secure penetration making it difficult to handle and requiring great power to pull it either empty or in operation, and making it too expensive for general operation on all classes of work.

The scarifier has a well braced steel frame to which are attached tooth standards and all mounted on a heavy four-wheel truck. The tooth bars are integral with the frame, the front end of which is lowered or raised independently of the rear end. In operation the front is lowered first and as the teeth begin to enter the ground the rear is lowered and the operation is made easy by the size of the hand wheels and the gears used for this purpose. The front is lowered through a toggle arrangement fastened to a worm segment operated in a unit casing preventing the possibility of the parts to get out of line and the rear end, which is similarily handled independently of the front, can be lowered on either side separately.

The front axle is of the rocking type and relieves the frame of twisting strains. The principal connections are riveted and parts subject to heavy strains are steel forgings. The tooth holders are of high carboned steel and the teeth are of the best grade of tool steel, heat treated and hardened.

The machine is furnished with nine teeth all of them removable so that for extremely hard work the usual practice is to operate only five teeth.

When the front end of the machine is lowered and the machine started, the teeth automatically enter the ground and the depth of cut is controlled by the bevel and worm gearing. The long wheel base enables the teeth to enter any kind of ground that is possible to tear up and insures steady running and even cutting because the teeth do not follow the inequalities of the road surface as in some other styles of scarifiers. The machine will stand the strain of a 45-h.p. tractor, but can be used with less power for many classes of work.

The machine has a wheel base of 146 inches, 64-in. tread for rear and 40-in. for front wheels. It has 9 tooth points of 1½-inch square steel and 1½x4-inch carbon steel tooth standards. The approximate weight of the scarifier with 9 teeth is 4,350 pounds.

OSGOOD RUBBER TIRED STEAM SHOVEL

The Osgood Company have just put on the market an 18¾-yard Traction Revolving Steam Shovel equipped with solid rubber tires built and furnished by the Firestone Tire and Rubber Company of Akron, Ohio.

These shovels are especially provided, as are all other Osgood 18 Traction Steam Shovels, with means for disengaging the traveling gears for towing by auto, truck or otherwise and with provisions for attaching the towing attachments or tongue. These features permit them to be towed with all machinery disengaged, thereby requiring only a minimum of pulling power.

For traveling over streets or highways under their own steam all of these size shovels are provided with a two-speed gear arrangement by which is obtained a traveling speed of 3½ miles per hour.

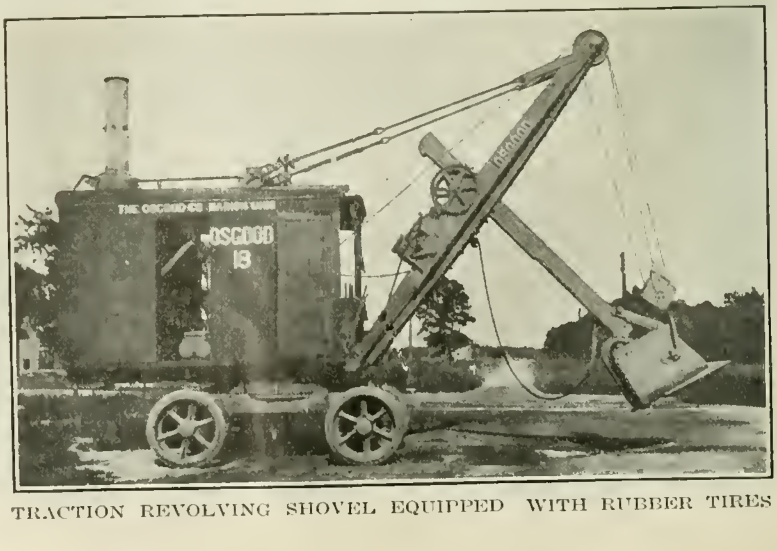
The tires are 40 inches in diameter, by 14 inches wide, ribbed tread, mounted on steel rims. These are pressed on the regular 34-inch diameter by 16-inch face cast steel wheels, which arrangement permits the removal of the tires when desired, and by attaching the cleats to the rear wheels, is then ready for service where it is not desirable to use the rubber tires.

This outfit so designed and mounted eliminates the damaging of thoroughfares, permits movement from one location to another with ease, decreases disturbance and delays along the route, whether towed or moving under its own power, permits them to be moved at an astonishing rate of speed and eliminates the vibration usually experienced when running on steel wheels.

DURABLE SMOKE RESISTING PAINT FOR STEEL

The Du Pont Magazine states that Du Pont Antoxide, a rust-inhibitive paint, is used on the steel flues that carry smoke to the largest smokestack in the world. This stack is 500 feet high and 72 feet wide at the base, with flues leading to it from the smelters of the Anaconda Copper Mining Company of Butte, Montana. On top of the masonry two additional steel flues discharge the smoke and hot gases into the air.

Antoxide has protected these flues for more than fourteen years—and the coating is still in good condition. No other paint tried has stood up under this exceptionally rigid service test longer than twelve months.



TRACTION REVOLVING SHOVEL EQUIPPED WITH RUBBER TIRES

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 51 OCTOBER 1, 1921 No. 14

Street Paving in Martinsville

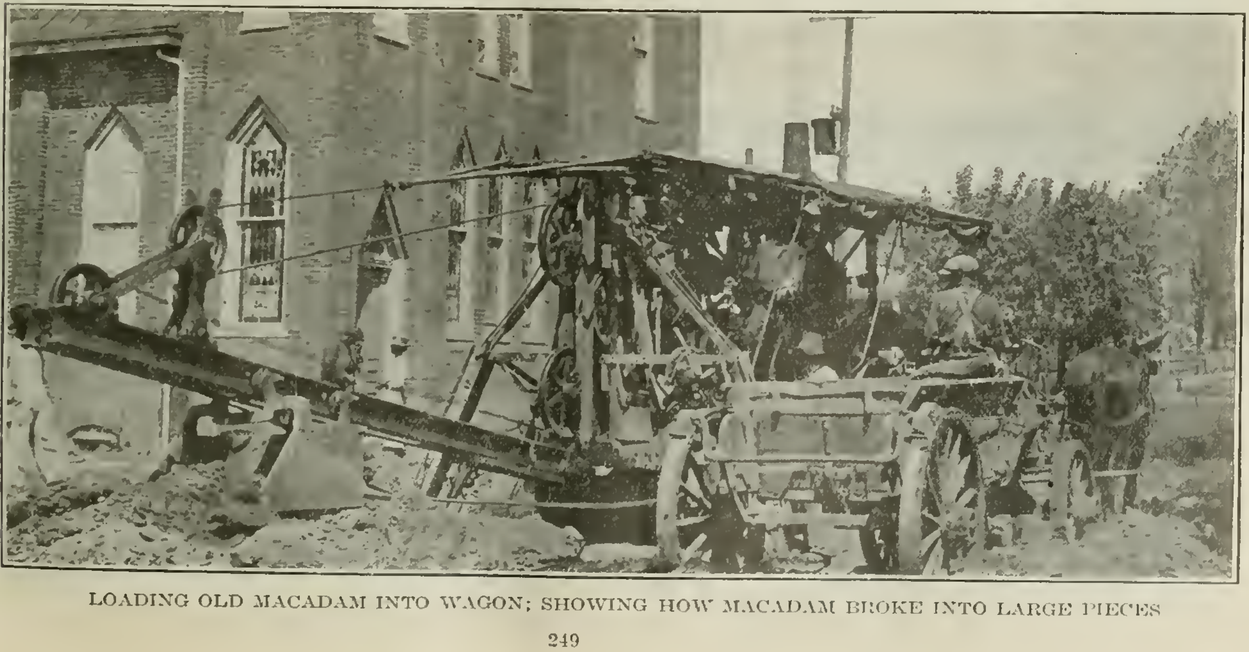
Old Macadam up to two feet depth removed by grading shovel, but cheap labor causes more hand work than formerly Concrete base thin because foundation unusually good. Distribution from central plants by one-horse carts.

Martinsville, Va., a town of about 4,000 inhabitants, is now engaged in carrying through a paving program, costing about $200,000, which will give a hard surface pavement for nearly every main street—in all about 3½ miles. Previous to this, Martinsville has had no paving, with the exception of some macadam on the principal streets, laid years ago and now entirely worn out. For the most part the new pavement consists of bitulithic on a concrete base, the remainder being bitulithic on old macadam, and a small amount of roughened concrete on the steeper streets. The work also includes considerable grading, some storm sewers, and about 8 miles of curb and curb and gutter. The work will be finished in the early fall.

The methods employed in the work are of interest as marking on another job the return to "man" days as contrasted to "machinery" days. Not all, of course, of the work is being done by hand, but men are plentiful and labor saving devices, with one or two fairly regular exceptions, are not in evidence. The use of a steam shovel for grading and motor trucks for hauling are more in the line of regular equipment than of labor saving devices. In all, about 200 men are employed on the work at an average wage of $2 per day each.

The paving to be done totals about 50,000 square yards of bitulithic surfacing two inches thick at $1.89 per square yard; about 50,000 square yards of 4-inch concrete base at $1.15; approximately 15,000 cubic yards of grading at $1 per yard; 23,000 feet of curb and gutter combined, at $1 per running foot; about 1,500 feet of storm sewer and 23,000 feet of granite curbing.

Grading is done by means of a Keystone grading shovel, equipped with a ⅜-yard bucket. Most of the excavation runs about 18 inches in depth, rarely more, but at times less. On average work, the Keystone shovel has turned out 300 to 400 yards a day. Watson 1½-yard wagons are used for nearly all hauling work. The shovel usually feeds two buckets to each wagon. The average time required to fill each wagon was 2 minutes.



LOADING OLD MACADAM INTO WAGON; SHOWING HOW MACADAM BROKE INTO LARGE PIECES not counting the time lost in moving or for other purposes. The number of teams required depended, of course, on the length of haul. Generally 6 to 8 teams were used to haul the material excavated by the shovel.

Most of the streets to be cut down are very hard to break up, as they have been maintained in the past by superimposing layer upon layer of macadam, until in some places they are 12 to 18 inches above the sidewalks. Occasional concrete cross-walks are encountered 12 to 15 inches underground.

As a rule, the street is cut to a few inches below grade, and the loose earth which piles along the sides just out of reach of the shovel is used as fill to bring it to the desired grade. Most of the streets are rather narrow, and the shovel easily cuts the entire width.

Following the shovel comes the first of the fine grading gang. These heap the excess material into windrows, meanwhile bringing the street to approximate grade and shape. These windrows are then handled by a team of mules and a jump scraper, and the material either used for fill where needed or wasted. The final finishing gang completes the street section, all work being done by hand.

Curbing and guttering are usually done in advance of the grading. The trench is excavated by hand work to the required size and grade, the forms are then set and the concrete poured. Wood forms are used exclusively. Curb protection bars are embedded at the corners. Concrete for the curb and curb and gutter is mixed in a Jaeger portable mixer, which is set up at convenient intervals, and is handled in steel body wheelbarrows. The concrete mixture for the curb and curb and gutter is the same as for concrete base, 1:3:6, but a half-inch facing of 1:2 mortar is used.

Considerable granite curb was already in place, in which case only gutter was built, the curb being reset where necessary.

The concrete base is only 4 inches in thickness and the mixture 1:3:6. This combination is usually considered rather light for modern traffic but the base foundation is quite uniformly good, and is carefully prepared in advance of laying the concrete, while the traffic is generally not very heavy in weight per wheel. Local sand is used, with Atlas portland cement and a good quality of blue trap for coarse aggregate.

Sand is dredged from a local creek, elevated into bins and loaded into motor trucks to be hauled to the city. Indiana trucks are used chiefly and are hired by the owner of the plant. The paving contractor buys the sand delivered on the job.

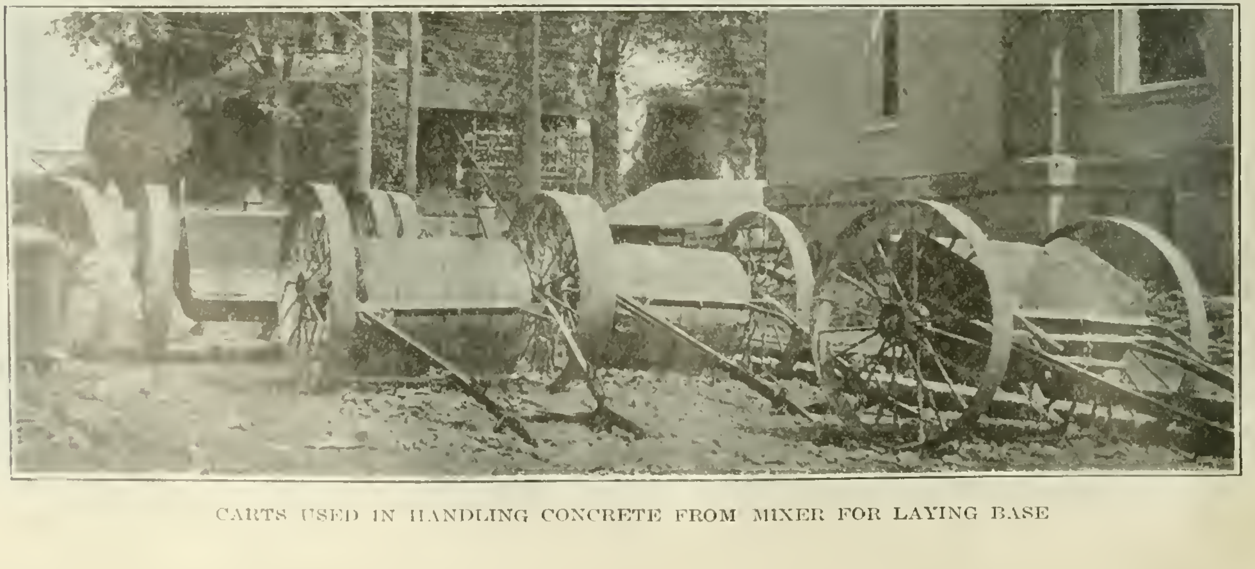
Stone is shipped in from the Bixley quarries and is unloaded in a converted coal shed, the trestle being boxed underneath and chutes installed so that the stone is dumped from the cars into the bins and discharged, all without handling, into the wagons. Teams, which are hired at $7.50 per 10-hour day, are used for stone hauling. Snatch teams are necessary on the steeper grades.

The method of handling the concrete for the base is somewhat unusual. At several points throughout the city, sand and stone are piled in large quantities. The mixer is set up at these points, and used as a central plant for furnishing concrete for all work within a radius of 500 to 1,100 feet.

The concrete is discharged from the mixer into 2-wheel steel carts, holding about a yard, to which a single mule is attached. These carts are hauled to the point desired and dumped, the concrete spread, and the cart returned for another load. An easy-dumping device makes the cart easy to handle and saves time in dumping.

By this means, base can be laid economically up to 600 feet from the mixer. It has been found necessary to work, at times, up to 1,000 or 1,100 feet from the mixer to save another move, but 600 feet is about the economical limit of distance. This method provides a simple means of employing the central plant principle without costly equipment.

The mixer used is an old Foote, which has been in use about nine years. Aggregate is handled from the piles to the mixer by means of steel barrows. The concrete carts are of steel, with metal wheels, shafts for one horse, and a metal body.



CARTS USED IN HANDLING CONCRETE FROM MIXER FOR LAYING BASE

The wearing surface is bitulithic laid in two courses, with a total thickness of two inches. Sand and stone are secured from the same sources as the aggregate for the concrete base, but is handled differently. The cars containing stone are dumped, as far as this is possible, in a flat track, and the stone shoveled from underneath them by hand, and then moved by slip scrapers to the elevators of the mixers. Sand is haulel to the job by trucks, dumped nearby, and also handled by scrapers.

A Warren portable plant is used for mixing the bitulithic. At present this plant operates by coal, though it may be changed over to burn oil. The daily capacity under the present arrangement is about 1,600 square yards of pavement.

The lower or binding course of pavement is the regular bitulithic, with aggregate passing 1⅛-inch screen; the top coat is regular graded sheet asphalt mixture with ¼-inch stone. The top coat varies in thickness from ¼ to ½ inch.

Hot stuff is hauled from the mixing plant, located on a siding at the railroad, to the job by two rented White trucks of 2 and 3½ tons capacity, respectively. On a haul of about a mile these two trucks recently hauled 204 tons of hot mix from the plant to the job in a 10-hour day. The trucks are usually loaded one ton in excess of their rating.

The specifications require that the hot material be dumped on a platform and then spread by shovels onto the base. Instead of the usual platform of planks, Superintendent Gassaway has an 8 x 8-foot plank platform mounted on very small, but solid, wooden wheels about 8 inches in diameter. This platform is equipped with a tongue and can be steered and handled easily.

The material is removed from the platform and spread over the concrete base, which has been thoroughly cleaned, by hand. It is compacted by a 10-ton Buffalo-Springfield roller with extra wide wheels.

On September 1, the work was about 60 per cent completed and was going forward rapidly. The contractor is the Atlantic Bitulithic Company of Richmond, Va., H. C. Gassaway, superintendent. Taplin & Perkins, of High Point, N. C., are the consulting engineers, with H. B. Ingram as resident engineer. J. R. Gregory is engineer and superintendent of the city, and J. F. Brown is mayor.

PORTABLE PLANT MIXING ASPHALTIC MATERIAL FOR WEARING SURFACE

Highway Engineering Fellowships

Our attention is called by Professor Blanchard to the fact that the highway engineering and highway transport fellowships in the University of Michigan are to be awarded not later than November 1, there being one fellowship in highway transport and three in highway engineering. Each fellowship pays $250 with an allowance of $50 for expenses and the holders of the fellowships do not have to pay tuition fees. Each fellow must hold a bachelor's degree and enroll as a graduate student in highway engineering or highway transport and as a candidate for the degree of master of science. He must be in residence at the college for four or five months during the college year. Applications for fellowships may be addressed to Professor Arthur H. Blanchard, University of Michigan, Ann Arbor, Mich.

Conference of New England Highway Officials

The Safe Roads Federation of Massachusetts has called a conference of the state highway commissioners and registrars of New England to discuss, among other problems, standardization of highway traffic regulations. The conference will meet in the State House in Boston on September 30 and will be presided over by John M. Cole, state commissioner of public works.

Public Work for Unemployed

The chief engineer for Middlesex county, England, Alfred Dryland, who recently arrived in this country to inspect American highways, says that 56 miles of arterial hard-surface roads are being built in the environs of London to cost about $6,000,000. This work is being undertaken at this time to afford employment to thousands of former service men and he believes that American state and city highway departments could do nothing more practical or patriotic than to give work to unemployed former service men in the construction of roads and similar public improvements.

Incidentally, Mr. Dryland believes that roads in America are altogether too narrow. He says: "Your roads are dangerous because the paved widths are too narrow for the amount of traffic they bear. There should be a minimum width of 30 feet of pavement, affording room for at least three vehicles to pass." Presumably he is referring to roads in the immediate vicinity of New York and does not refer to highways outside of the metropolitan districts. For to construct all of our highways throughout the country of that width would unnecessarily restrict the mileage that could be constructed with the funds, materials and labor available.

T. H. MacDonald, Chief of the United States Bureau of Public Roads, states that immediately after the expected passage of the highway bill now before Congress, construction will be commenced on a large number of new projects, particularly in the west, where unemployment is acute, and the prospects are for an unprecedented amount of road construction this year, even exceeding that in 1920, which was far greater than ever before.

Mending a Leaky Stave Pipe

A wooden stave water main in Norfolk, Va., is 24 inches in diameter and about 10 miles long, with pine staves 2 inches thick, machined, wound with 14-gage wrought iron bands ¼ inch apart. It was completed in 1913 and operated under a pressure of about 20 pounds until 1918 when an examination and test showed that the weight of the two-foot fill above the pipe had flattened the cross-section to an elliptical shape, and a pressure of 21 pounds per square inch caused an almost continuous leakage amounting to 2,400,000 gallons per day in the first 24,000 feet length of the pipe.

The pipe was then reinforced by ⅝-inch circumferential rods with malleable iron lugs. The joints at the ends of the staves were scraped all around the pipe and for a width of 12 inches calked with lead wool. They were then covered with a strip of rubber 1½ inches wide and ¼-inch thick, around the entire circumference except for a 6-inch space at the top between the ends of the rubber, where double iron lugs were seated and received the ends of a 3/16 x 1¼-inch steel band flattened from a ⅝-inch rod, one end of which was riveted to the lug and the opposite screw end secured to the lug by a nut. As the nut was tightened the bar was hammered until the joint leaks were closed. The joints were about 8 feet apart and 25 of them were repaired daily by two men. The subsequent test showed the leakage of 1,700,000 gallons daily in the first 11,000 feet of pipe under a pressure of 29 pounds, increased to 4,600,000 under a pressure of 30 pounds. In the first 6,500 feet of the pipe, which had been almost continuously reinforced by the ⅝-inch rods, the leakage was only 43,000 gallons daily under 42 pounds pressure and 1,100,000 gallons daily under 64 pounds pressure.

Biological Survey of River Pollution

Indications of pollution and self-purification of Sangamon river in a distance of seventy-five miles as given by the animal and vegetable contents of water and bottom mud. Conclusion therefrom. Investigation by Illinois State Water Survey.

An interesting investigation was concluded about two years ago by Minna E. Jewell, chemist connected with the Illinois State Water Survey, and described in the report of that survey for the years 1918 and 1919, which has recently been published. General interest attaches to this report because of the attention which it calls to the use of biological surveys of river water and biological and chemical analyses of the mud at the river bottom as a means of judging the amount of pollution and self-purification of a river receiving sewage.

The survey referred to was made of the Sangamon river between Decatur and Springfield. The river is normally a small stream consisting of alternate pools from three to ten feet deep and riffles a few inches deep. The water reaches Decatur in a relatively normal, unpolluted condition and provides the public water supply of that town. In dry weather Decatur uses all of the water in the river so that none whatever flows past the city, but most of it is returned to the channel as crude, undiluted sewage. As the river receives no important tributaries for at least 100 miles, the changes that take place for that distance below Decatur are primarily those due to so-called self-purification.

A biological survey was made of the river above Decatur in order to ascertain the normal inhabitants of the stream and their abundance. Above Decatur the pools had a gravel bottom frequently covered to a depth of several inches by a deposit of fine sand, soil and decaying leaves. They contained an abundance of clams, of which eight species were noted, while a typical square yard of bottom from a riffle was estimated to contain 40 snails, 3 clams, 40 insect larvae, 30 ephemerid nymphs and 10 coleopterous larvae. Numerous fish 12 to 16 inches long could be seen swimming a short distance below the surface. The sewage of the small town of Monticello is discharged into the river after preliminary treatment in a septic tank but the effect is purely local, disappearing entirely within ¾ of a mile.

An examination of the river was made on October 5 to 8, and the appearance one mile below Decatur was that of sewage, 6 miles below it was inky, 20 miles below inky but opaque, 35 miles below dark slaty, 50 miles below milky, 60 miles below gray and turbid, 70 miles below greenish-gray, and 78 miles below green. The odor was described as putrid 6 miles below, septic from 20 to 39 miles below, disagreeable at 53 miles, faint at 70 miles, noticeable at 75 miles, above a dam, and had entirely disappeared ¼ of a mile below this dam. Dissolved oxygen was entirely absent for 35 miles below Decatur, a trace was found at 39 miles, which had disappeared at 60 miles. At 75 miles below, 4.1 parts per million were found above the dam and 7.8 parts just below the dam, increasing to 9.7 parts 3½ miles below the dam.

Immediately below Decatur there was a complete disappearance of bottom animals and these did not make their first appearance until 30 miles below and even there only the tubificid worms were found, which are capable of living in the complete absence of free oxygen and are typical sludge worms. Twenty miles farther down the chironomid larvae were found, these also being capable of anaerobic existence. Soon after the first crayfish appeared, but no other bottom forms were found until 75 miles below Decatur. At 60 miles a few fish were found that had entered from a small tributary creek, but these were dying or showing signs of great distress. Seventy-five miles below Decatur is the dam above referred to, about 8 feet high, and as the water flows over this, considerable mechanical aeration is obtained. Above the dam the dissolved oxygen analysis showed 48.9 per cent saturation while ¼ of a mile below there was 93 per cent of saturation. Immediately below the dam there was a return of the normal animal life, but this and the dissolved oxygen again disappeared a few miles further on, which was explained by the supposition that sufficient putrescible matter remained in the water to absorb the oxygen mechanically introduced at the dam. A little distance further on, however, the river permanently recovered its normal condition.

Discussing the results of the survey, Miss Jewell reports that "the plankton of a stream afford a good criterion of the quality of the water at the time it is collected. On the other hand, the bottom animals offer a criterion of the worst condition to which the locality is subject." The biological and chemical survey showed:

"1.—Plankton animals present varied greatly with season and water level. During the low waters of early fall only sewage and highly tolerant forms were found within 75 miles (by river) of Decatur.

"2. The normal bottom fauna disappeared entirely below Decatur. Only typical sludge worms (tubificids) were found in the first 40 miles. The highly tolerant midge larva appeared within the next ten miles. Seventy-five miles below the source of pollution several of the normal bottom animals reappeared and about 10 miles further down the normal bottom fauna was re-established.

"3. Dissolved oxygen drops off, frequently to zero, below Decatur and at low water sufficient oxygen to support ordinary aquatic animals is not found again within 75 miles.

"4. Oxygen consuming power of the water, organic nitrogen and ammonia rise rapidly immediately below Decatur and then gradually decrease to normal.

"5. Dissolved oxygen consumption, organic nitrogen and ammonia of the water fluctuate greatly with the temperature and volume of the stream.

"6. Ammonia content of mud from the bottom of the river increases suddenly below Decatur and then decreases gradually to normal (about 80 miles below).

"7. The ammonia content of the mud from any given location shows a seasonal variation due to temperature and oxygen content of the water. Slight temporary fluctuations in water level do not appreciably affect the ammonia content of the mud.

"8. The worst conditions occur in the upper part of the river during hot, dry summers, and in the lower part of the river in the early spring following a severe winter.

"9. Chemical analyses of the water and mud afford the best criterion for the degree of pollution of the water at the time the sample is taken. The animals of the bottom form the best criterion for judging the worst conditions to which the location is subject."

Sanitary Engineers of the U. S. Public Health Service

Until about eight years ago the United States Public Health Service functioned entirely through members of the medical profession in all its grades, but at that time it began utilizing sanitary engineers and the number of these has increased until 27 sanitary engineers are now connected with the Public Health Service.

However, the medical officers of the service are commissioned, while the sanitary engineers are on a civil service status and are, therefore, subject to dismissal whenever congressional appropriations for special work fail to be made. Consequently the engineers now in the service do no feel secure of their positions and it is hardly to b expected that young engineers would be attracte to the service under such conditions. Moreove engineers in charge of public health service work sometimes are unable to command the respect from citizens that they would receive if commissioned as are the medical officers.

On July 1 a bill was introduced in Congress to commission the sanitary engineers on the same basis as the medical officers. This bill is before the Interstate and Foreign Commerce Committee of the House and it is expected that it will be brought up for consideration when Congress convenes after the recess. The Surgeon-General is reported to have said that "it is the desire of the bureau that any reorganization bill should provide for the commissioning of the engineers of the service." The Treasury Department has gone on official record as stating: "Legislation which would enable sanitary engineers to be commissioned in the Public Health Service on the same status as medical officers would benefit public health work and attract competent sanitary engineers who wish to make a public health career their life work." The Surgeon-General, in his report for the year ending June 30, 1920, reported that resignations of engineers from the service had exceeded admissions during the previous twelve months.

The bill does not involve any additional expense to the service, the sanitary engineers at present receiving compensation equivalent to that of medical officers in the service of the same grade.

Touring Hetch Hetchy Water Supply

The Yosemite National Park Company has opened at Mather, Cal., the Hetch Hetchy Lodge with dining room and sleeping accommodations for 30 people to serve as a base for motorists to take the White buses operated with flange wheels on the Hetch Hetchy Construction Railroad that in 68 miles makes 98 complete circles of curvature, overlooks the beautiful Tuolumne canyon, and enables the tourists to visit the dam site and the long tunnel under the Sierra Nevada mountains and return the same day.

Insuring Purity of Plattsburg's Water

Recommendations of consulting engineers for chlorinating, algae removal, and cleaning of distributing reservoirs.

In a recent report on the quantity and quality of the water supply of Plattsburg, N. Y., Messrs. Metcalf & Eddy have embodied certain recommendations, and instructions for carrying out expedients recommended, for securing and maintaining the safety of the supply which will be of interest to other cities as well.

The supply is obtained from two brooks and is treated with chlorine, the water from one brook being treated by an automatic Wallace & Tiernan chlorine apparatus, while that from the other is dosed by means of a manual control apparatus. The engineers report that each piece of apparatus is capable of satisfactorily disinfecting the supply but "the point cannot be overemphasized that the apparatus must be operated uninterruptedly and sufficient amounts of chlorine be supplied at all times to show excess chlorine" in samples allowed to stand for 15 minutes after being collected. A slight excess of chlorine taken at the plant "will not appear in the water delivered to the city, due to the absorption of the chlorine by the organic matter of the water during the flow through the long lines to the distributing reservoirs."

Owing to the distance of the chlorinating plants from the city, it is impracticable for the superintendent of public works, Mr. Burke, to give this apparatus the attention it should receive and it is recommended that this be performed by an employee regularly assigned to this duty who is competent to change the chlorine cylinders, to use judgment in the application of the chlorine based upon the tests for excess chlorine (which he should make at least twice daily), to keep records of operation, and to familiarize himself with the apparatus so as to be able to make minor repairs and adjustments. This will not take up all of his time and he could also be instructed to attend to the regulation of the valves in the pipe lines at and near the reservoirs, patrol the reservoirs, assist in reforestation work and perform other duties in the vicinity of the reservoirs.

The reservoirs at the intakes are shallow and considerable trouble has been experienced with tastes and odors due to algae growths. "It would be possible to obviate to a considerable degree the troubles arising from such algae growths by the application of proper amounts of copper sulphate to the reservoirs in late spring or early summer and by repeating such application at regular intervals during the summer months." The engineers do not recommend such treatment late in the season, however, when the growths have progressed to such an extent that the destruction by copper sulphate of large numbers of algae would temporarily cause an undesirable amount of taste and odor.

However, in the case of the distribution reservoirs, "on account of the small storage in these reservoirs and the frequent replacement of the water therein, the objection to the use of copper sulphate which exists at the present time in the case of the large reservoirs does not apply. In order to minimize the growth of algae in the distribution reservoirs and to improve somewhat the physical quality of the water in them, steps have been taken to clean them, provide additional chlorination of the water used for refilling on account of possible contamination incident to the cleaning of the reservoirs, and to use copper sulphate in the refilled reservoirs to kill the algae growths remaining on the walls. The north basin has already been cleaned and two to three inches in depth of humus matter flushed out, together with large numbers of frogs and tadpoles. The first million gallons of water admitted to this basin was given additional chlorination before any water from the basin was admitted to the distribution system, by the application of about nine pounds of chlorine. As soon as this north basin becomes filled to its normal depth of 10 or 12 feet, copper sulphate is to be applied in the proportion of one part per million by weight, or 8 1/3 pounds per million gallons of water. . . . The south basin has already received one application of copper sulphate. As soon as the north basin becomes filled, the south basin is to be emptied, cleaned, refilled, chlorinated and copper sulphate treatment again applied.

"By cleaning these distribution reservoirs, the removal of decomposing organic matter will be effected, and by copper sulphate treatment algae growths in them will be kept at a minimum. The copper sulphate treatment in the reservoirs should be repeated every two weeks until fall. While this treatment cannot affect very markedly the character of the water coming from the storage reservoirs, it will prevent additional tastes and odors developing from algae growths in the distribution reservoirs themselves."

Aeration of the supply at the distribution reservoirs would be very desirable but the necessary head cannot be spared from the city pressure.

The engineers recommend certain precautions for preventing pollution of the water that are not, we fear, always observed by other cities besides Plattsburg. "The floor of the gate house over the well into which water from the south reservoir discharges before entrance into the main to the city is of plank with open joints. These open joints permit dirt and dust carried into the gate house on the boots of the workmen and visitors to fall into the water going to the city. Such pollution can be prevented by covering this floor with a tight canvass deck and by building a raised framework for the trap doors to rest upon. Furthermore, collars should be put around the valve stems."

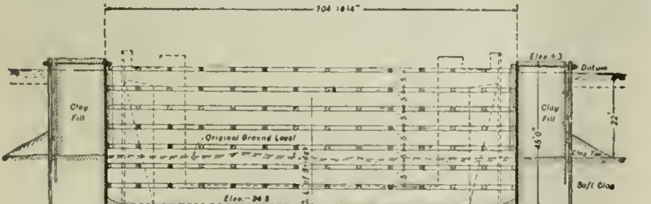
Crib and Cofferdam Work*

Telescopic steel sheet pile cofferdam. Design and methods of installation of interior bracing. Floating, sectional and detachable cofferdams, anchoring and sealing crib cofferdams.

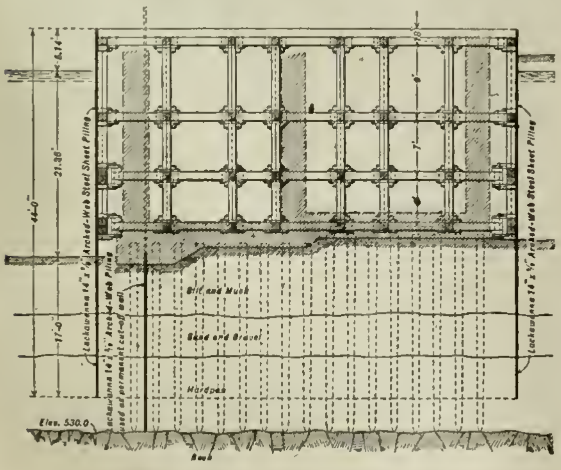
The piers for the ten 160-foot spans of the concrete arch double track Tunkhannock railroad viaduct have 46 x 36-foot foundations on rock, some of them 90 feet below the surface of the ground and 60 feet below water level. They were built in telescopic sheet pile cofferdams, made with two offset tiers of steel sheet piles, the upper and outer one having inside dimensions 10 to 12 feet greater than those of the inner or lower one.

Inside and outside top and bottom waling pieces 6 feet apart horizontally and vertically were assembled to form a framework on the surface of the ground and between them there were driven to a penetration of about 16 feet the piles forming the lower section of the cofferdam.

After this was completed the piles forming the upper sections were similarly driven concentric with them, after which the space between the inner and outer piles was excavated and the space inside the inner piles having been previously excavated the inner piles were again driven and the bracing shifted downward as the excavation progressed within, and the exterior piles were again driven another 15 feet, the material between the two sets of piles was excavated, and so on, until the inner piles reached bed rock and the tops of the outer piles reached the surface of the ground, as shown in the third figure, page 197.



UPPER TIERS OF BRACING ASSEMBLED BEFORE SINKING IN POSITION


8.14'
21.36'
44'-0"
17'-0"
18'
6'
7'
Lackawanna 14" x ½" Arched-Web Steel Sheet Piling
Lackawanna 14" x ½" Arched-Web Piling used as permanent cut-off wall
Lackawanna 14" x ½" Arched-Web Steel Sheet Piling
Silt and Muck
Sand and Gravel
Hardpan
Elev. 530.0
Rock

HEAVY BRACING AND FOUNDATION PILES IN COFFERDAM FOR CONSTRUCTION OF PUMP WELL

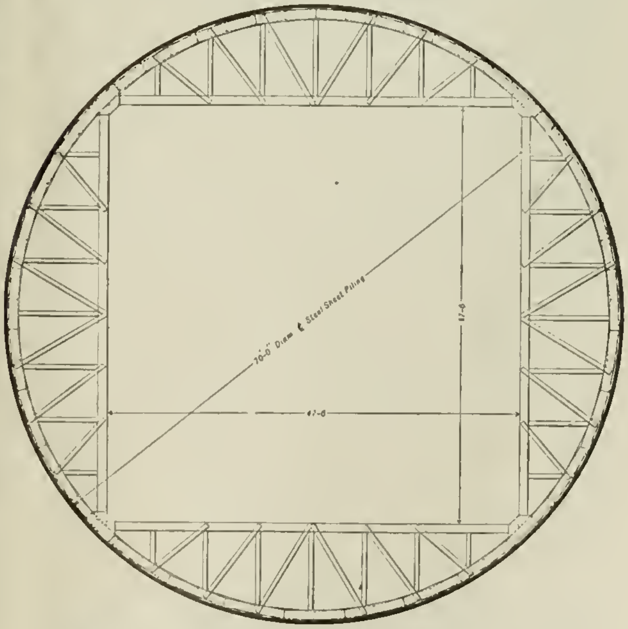
STRENGTH AND STABILITY

Where the water level is to be very much higher on the outside of the cofferdam than inside, the cofferdam must resist tremendous horizontal pressure due to the hydro-static head and provision must be made to prevent overturning, bending, and horizontal displacement. If the cofferdam is a complete enclosure a number of these forces may be resisted by heavy interior longitudinal and transverse cross struts, but these are sometimes very objectionable because of the obstruction they offer to the construction operations inside the cofferdam beside which they are likely to be complicated and costly.

If the cofferdam is very wide it may be almost impossible to provide adequate interior bracing and in some cases of this nature the cofferdam has been made to have independent stability by building a series of interconnected cells made of interlocking steel sheet piles and filled with earth and reinforced if necessary by interior embankments.

This was the case of the famous cofferdam for the recovery of the battleship Maine sunk in Havana harbor just before the Spanish war and for the construction of Black Rock United States Government Canal Lock at Buffalo. In both cases the bottom was very soft and the water deep and long heavy steel sheet piles were driven to form a series of connected cylinders with long diameters filled with the soft excavated material.

A similar construction was also used in the cofferdam enclosing the river side of the excavation for the Municipal Piers at 43rd street, New



SYSTEM OF INTERIOR TRUSSED BRACING PROVIDING LARGE CLEARANCE IN CIRCULAR LACKAWANNA STEEL SHEET PILE COFFERDAM

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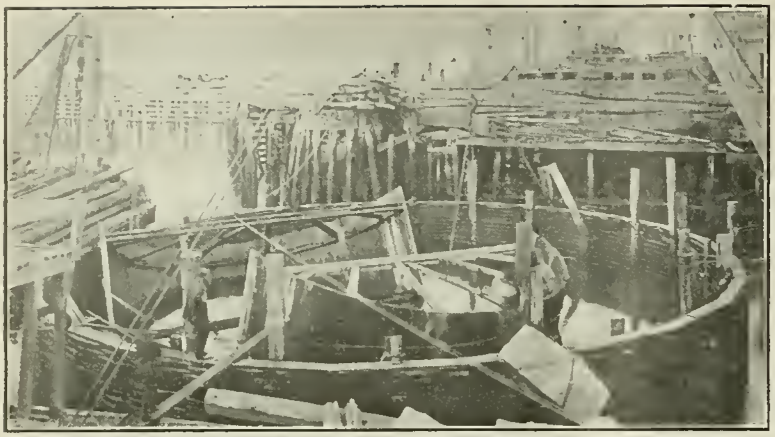
*Continued from page 198.



CHELSEA COFFERDAM COLLAPSED BY HEAVY PRESSURE ON INNER WALLS

York, illustrated on page 198. In all the cases mentioned the construction was massive and expensive but efficient, the intake being so small that it was easily controlled by the pumping plant installed.

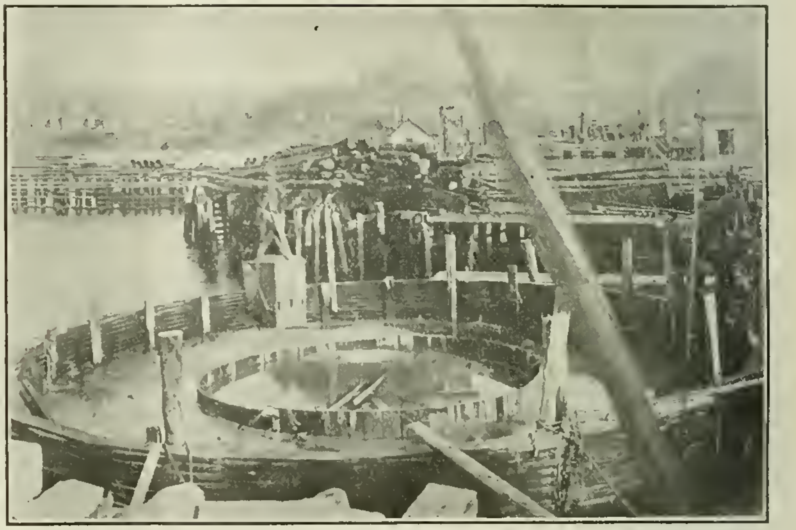
High cofferdams with short sides may have their bracing constructed complete on shore, launched, floated to position and sunk to form a guide on the exterior of which sheeting is placed or sheet piles are driven to enclose the framework and take bearing against it, or if the cofferdam is not too large, the piles may be driven and the assembled bracing placed inside by derricks before the cofferdam is unwatered. This method provides for the efficient construction and proper placing of interior framework below water level and enables the cofferdam to be unwatered without hesitation as soon as it is completed.

FLOATING AND DETACHABLE COFFERDAMS

For bridge piers, especially those that are built on foundation piles cut off below water level, floating cofferdams are sometimes provided in which construction is carried on and the structure sunk to final bearing within the cofferdam after which the cofferdam is detached and may be used again for similar structures in the same series. Such a cofferdam is also called a floating caisson and usually consists of vertical side panels with timber frames and heavy flanges bolted or hooked together with gaskets at the corners and bolted or hooked to a solid, watertight bottom that remains permanently in place supporting the pier above it when the sides are detached and floated away.

Formerly the bottoms were made of timber, but recently considerable economy and other advantages were attained by J. W. Rollins, Jr., who has done important work, for which he built a reinforced concrete bottom to which were attached with gasket bearings the detachable wooden sides thus saving the cost of constructing a temporary wooden bottom and eliminating all wood from the pier construction.

Somewhat similar to the floating cofferdams are detachable cofferdams, frequently used in the construction of foundation piers for very tall buildings where the excavation is not completed at the time the piers are built and the cofferdams attached to the tops of the piers are carried above the temporary surface of the ground to exclude earth and water and permit the framework to be constructed on the piers simultaneously with the completion of the general excavation as has been done with the Woolworth building and other office buildings in New York.



DOUBLE-WALL CHELSEA COFFERDAM BEFORE UNWATERING WAS COMMENCED

These cofferdams usually are sectional with steel panels that can be separated or moved at pleasure, or when of small dimensions, are often riveted steel cylinders. Similar cofferdams are also attached to pneumatic caissons to permit working on top of them or to serve for forms for concrete piers on land or water or for both purposes and are usually detached after the structure is finished. In large bridge piers the cofferdams are frequently confused with the caissons themselves and are even built structurally continuous with them and may be considered or referred to as either caissons or cofferdams.

Where they are built to considerable height as in the piers for the East River bridge at New York that were sunk to a depth of more than 100 feet below water level, the cofferdams were of massive wooden construction heavily braced with many tiers of cross timbers and sometimes with horizontal trusses. The thickness of the walls varied from 12 inches at the bottom to 3 inches at the top, and the upper tiers of the cofferdams were generally made detachable while the lower tiers were made permanent and remained fixed in position when the structure was completed.

CRIB COFFERDAMS

When cofferdams have to be built in very swift water, or if the water is deep, or the bottom has an irregular surface, or is strewn with boulders, the construction of a cofferdam is very difficult, particularly if there is little or no earth available and in such case crib cofferdams are commonly used.

These consist simply of a rectangular framework built up of round or square timber laid together cob house fashion, and drift bolted at intersections where the timbers may be laid with whole face, notch, or half-notch bearings, making open or solid walls.

The lower courses are carefully cut to conform to a profile of the bottom as determined by careful soundings, and the cribs are either built complete on shore of small enough dimensions and swung to position by derricks or are partly built, launched and completed while floating.

In either case they are provided with interior compartments, two or more of which are floored to retain stone ballast which is filled in as they sink, care being taken to maintain them in position end to end and thus form the skeleton of the cofferdam. The cofferdam is completed by filling the cribs with earth or stone and usually depositing an embankment of earth or puddle or rip-rap or both on the upper side and if sufficient puddle clay is not available by sheeting the upper side with vertical planks, spiked or bolted to the crib under water by divers after the planks, which are often cut to chisel edge at the bottom, are driven hard to broom up against the surface of the rock and make a fairly tight joint there.

Additional tightness is also secured often by the use of an apron or heavy canvas 6 or 8 feet wide, one edge of which is securely nailed to the crib on a horizontal line just above the bottom and the remainder of the canvas spread flat on the bottom and covered with clay or earth.

Cribs can have any required dimensions that are convenient and are generally from 10 to 20 feet wide and from 10 to 40 or 50 feet in length. Ordinarily they are not more than 30 feet in height. If the bottom is smooth and regular, either horizontal or inclined, and the current is heavy, it may be necessary to anchor the cribs in position, which is sometimes done by drilling holes in the surface of the rock with submerged drills and setting in them heavy vertical steel dowel pins that project above the surface of the rock to engage the crib work.

DERRICK HANDLING 150-TON REINFORCED CONCRETE COFFERDAM IN 12 FEET OF WATER FOR PUMP WELL AT STAMFORD, CONN.

Derby-Shelton Bridge

The new bridge across the Housatonic river, between Derby and Shelton, was built by the Connecticut State Highway Department to replace an old structure with 50-foot plate girder arch spans that had become inadequate for the increasing traffic.

Steel sheet pile cofferdams were constructed adjacent to the old piers and in them excavations were carried down to a gravel stratum on which there were built the new concrete piers.

Between each pair of piers were driven five transverse bents of pile trestles that were capped about 10 feet above the spring line, where they supported longitudinal timbers carrying vertical and inclined posts supporting wooden arch ribs that extended beyond the ends of the falsework bents, to the pier coping, the projecting sections being carried by blocking on steeply inclined chord pieces, resting at the lower ends on the caps of bents seated on the footings of the piers and at the upper end seated on the inclined end of the longitudinal timbers to which they were scabbed. The transverse pile caps were double with pairs of folding wedges inserted between the upper and lower tiers, thus providing an adjustment to strike the centers after the arch was completed.

The arch rings, which were continuous cylindrical segments, were for convenience built in successive longitudinal halves, the falsework being shifted from the first to the second after the completion of the former.

The aggregate was delivered over a service track to a wooden hoisting tower located near the center of the bridge and from it the concrete was spouted to position through steel chutes suspended by light manila tackles from steel cables attached to the tower and supported intermediately when necessary on moveable A-frames.

The arches were bonded to the piers by reinforcement rods projecting from the skewback to the arch curve. Vertical reinforcement imbedded in the arch ring projected above it to bond with the reinforcement in the spandrel walls, and horizontal transverse anchor rods were also imbedded in the arch ring near the center line and projected from it to bond the first section of the arch to the second. During the removal of the old bridge and the construction of the new one traffic was maintained on an adjacent pile trestle by-pass. The new bridge was built by the Arthur McMullen Co., of New York.

A view of this bridge under construction is shown on the front cover of this issue.

Imhoff Tank Patents

Patents for the Imhoff sewage treatment tank were originally taken out by Dr. Carl Imhoff about eleven years ago, during most of which time the Pacific Flush Tank Co. has acted as commercial representative for Dr. Imhoff in the United States and Canada. When the United States entered the war, Dr. Imhoff became an alien enemy and the Federal Trade Commission permitted this company to continue to license towns in behalf of the United States government. On March 1, 1919, the alien property custodian, acting under the provisions of the Trading with the Enemy Act, siezed the Imhoff patents and sold them to the Chemical Foundation, Inc., which will continue for the life of the Imhoff sewage tank patent to issue licenses for the use of Imhoff tanks, through the Pacific Flush Tank Co. as its agent, the patents, therefore, now being owned entirely by American interests. The royalties will be the same as before, varying from $10 for a population of 100, to $430 for a population of 10,000 and up to $15,000 for a population of 2,000,000.

Newark's Garbage Piggery Bankrupt

Some months ago we published the information that Newark, N. J., had contracted with a private company for disposing of garbage at a profit to the city, this company having agreed to purchase it and intending to use it for the raising of pigs. During the first half of September the purchasing company, the National Utilization Co., notified the Department of Streets and Public Improvements that it would have to discontinue operating under its contract, since low prices for pork had forced the company into bankruptcy, having been compelled to buy its pigs and garbage in a high market and sell them in a lower one. The city officials hope that some arrangement can be made by which the piggery can continue operation, although it does not seem probable that the city can continue to receive any money for the garbage but will probably have to give it to the company or its successor.

Municipal Improvements in Pittsburgh

The director of public works of Pittsburgh, Pa., has stated that on September 1 more than $6,000,000 worth of municipal improvements were under way and bids for an additional million dollars' worth are now being advertised. The work consists of street improvement and playground and sewer construction for the most part. The largest item is $300,000 for improving Brownsville avenue. The Hazlewood sewer system will cost $80,000. Two viaducts on the Boulevard of the Allies are other large pieces of work included in the total.

The Bethlehem Viaduct

The city of Bethlehem, Pa., is building a viaduct which it calls a hill-to-hill bridge, which connects two sections of the city that are divided by a deep valley. This viaduct is said to be the longest structure of the kind in the state. Including four ramps connecting with intersecting streets, it will be 1½ miles long and have a total area of about 7 acres. The four intersected streets will connect with the bridge on each side, giving eight entrances. About 200,000 tons of concrete, 1,700 tons of steel reinforcing and 400,000 granite paving blocks will be used in the construction. The cost has been allocated by the public service commission between the city, the two counties concerned and the railroad interests, the city paying about $500,000, the railroads $600,000 and each of the counties about $600,000, or nearly $2,500,000 total.

St. Louis' Municipal Exhibit

A municipal exhibit is to be held in the public library of St. Louis from October 1 to November 15, at which will be shown the work and methods of work of the various departments and institutions of the city. This exhibit is, we believe, being gotten up by the Municipal Reference Library as a part of its service of education of the citizens.

The Federal Power Commission has issued a permit to the Utah Power & Light Co. for about 21,500 h. p. development on the Bear River in Southeastern Idaho. A permit has also been issued to the Roanoke River Development Co., Richmond, Va., for the construction of a high dam across the Roanoke river at Beggs Island, Clarksville, Va., and a power house with a primary development of about 10,000 h. p. for general utility and industrial purposes.

The city of Chicago has received a permit from the War Department for the extension of the shore line of Grant Park 300 feet into Lake Michigan, permitting the construction of a boulevard from the Field Museum to Jackson Park. The work will be executed under the direction of the South Park Commission that is now making plans for a 200 x 600-foot pier and breakwaters and other structures.

A joint commission of five men from the United States and five from Canada has been appointed for the bridge and tunnel across the Niagara river at Buffalo, the congressional bill for which is now pending.

PUBLIC WORKS

Published Weekly
by
Public Works Journal Corporation

Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba..$3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
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Engineers in Public Health Service

Up to a few years ago it was generally held that all matters connected with the public health should be in charge of a physician and among such matters were included sewerage, collecting and disposing of garbage and other matters which have since been taken out of the hands of local health departments. In some cities inspection of house plumbing is still left in the hands of the health department, but the number of these is rapidly decreasing.

There still remains, however, considerable of an engineering feature to the work of health departments, whether local, state or national. So true is this, that health officers who serve as the executives of health boards or departments now receive their training, where any special training for this service is obtained, in engineering schools rather than in medical colleges.

Another indication of this is the great and increasing importance assumed by engineers in the work of the United States Public Health Service. As noted on another page of this issue, during the past eight years the number of sanitary engineers connected with the department have increased from none to 27 and a bill is now before Congress to commission the engineers and place them on the same standing as the medical officers of the service.

One reason for this prominence of engineers in health service is that the chief duty of a public health board is in general that of the prevention of disease while, in spite of much that has been written and said to the contrary, the medical profession still confines itself largely to cure rather than to prevention. Another reason is that prevention includes a considerable amount of engineering work such as the construction of sewers, purification of water, drainage of lands, etc.

It would seem as though an ideal arrangement would be a still further divorcing of the medical and the engineering features of health work, leaving to the health officials only the determination of when and to what extent the health of a community calls for sewerage, water purification, mosquito extermination by drainage, etc., and providing that other departments carry out the engineering features necessary to produce these results.

It is exceptional that a physician is so constituted mentally as to be able to properly direct engineering work or other operations involving the direction of workmen and use of materials, which is so entirely foreign to the duties of either the ordinary practitioner or the specialist in medicine. It would seem more logical therefore to entirely remove from the Public Health Service, which probably will always retain medical men at its head and in the highest official positions, the carrying out of any work calling for engineers, and to place this work in charge of a bureau which is properly officered and organized for carrying out such work.

However, if engineers are to be connected with the service, it is greatly to be hoped that the bill now before Congress will pass, giving them an equal standing with the medical officers and thus attracting to the service a high grade of men such as the country should employ for one of the most important duties that any federal employees are called upon to perform.

Public Works as Temporary Solution of Unemployment

A number of state officials and others throughout the country are advocating the extension of road work in order to give employment to the large number of unemployed labor throughout the country, and some cities and states are doing more or less along this line. For instance, in Bridgeport, Conn., there are said to be about 30,000 unemployed because of the closing down of plants called into existence by war necessities and the city is endeavoring to give employment to as many as possible of these by doing street grading in outlying sections, where it is not probable that paving will be carried out for some time to come and where consequently the grading might have been postponed for some months or years under other conditions.

A few days ago we received from R. C. Marshall, Jr., general manager of the Associated General Contractors, and who has been appointed by President Harding as a member of the Conference on Unemployment, a request for suggestions as to possible solutions of that problem. In response we submitted the following, and recommend it to the consideration of all state highway officials and others in charge of public works:

> So far as unemployment in connection with public works is concerned, it seems to us that the fundamental reason, or at least one of the principal fundamental reasons for such unemployment is the feeling which persists quite generally among officials and taxpayers that manufacturers of and dealers in materials used in such works are attempting to keep prices at a level that is not justified by present conditions and those of the immediate future, and those in charge of public works are holding off in the belief that prices will be materially reduced either this year or next, or else because they feel that, whether or not such early reduction is probable, they cannot afford to undertake any large amount of work at existing prices.
>
> Undoubtedly skilled labor is partly responsible for this in that it is endeavoring not only to retain present wages, but in a number of cases to increase them, and in some trades increases have actually been granted within the past month. There is a general feeling, however, that manufacturers and other employers of skilled labor are as much to blame as labor itself for the failure to lower prices of materials.
>
> If the above opinion is approximately correct, it would seem as though the ultimate solution of the unemployment problem must involve the securing of concerted action by both employers and employees whereby wages and profits will be reduced and business brought back more quickly to approximately a pre-war basis.
>
> This will probably take time, however, and there is need for immediate action. We can think of no way in which employment can be offered on a large scale more promptly than by the construction of public works by cities, counties and states, and especially such classes of work as call for large amount of hand labor. A suggestion is offered by the action of Bridgeport, Conn., where, in view of an estimated number of 30,000 unemployed, many of them semi-skilled men, the city is performing as much street grading as possible, using pick and shovel for this work to a large extent. Other cities might proceed to the carrying out of street opening plans by grading streets which they do not yet feel able to pave, and county and state highway departments might similarly put under way a considerable amount of road grading, although it may be months or possibly years before all of these roads will be surfaced. Many of the states have abundant funds for employing large numbers of men on road work, but have postponed such work because of the high cost of materials.
>
> PASS A FEDERAL ROAD BILL AT ONCE
>
> Other action which could be taken at once, and should be taken at once for other reasons as well as this, is the passing by Congress of a road bill which will provide for continued federal aid to states in road construction. Until such a bill has been passed the states cannot know how much money to count on next year or after their present allotments have been used up, and will therefore be unable to make any plans for the future. Also, some of them whose funds are running low may not wish to completely exhaust these until they learn whether and how much federal aid will be granted them next year.
>
> During the past few weeks a concerted effort has been made to persuade state and county highway officials to complete plans for beginning next year's highway work early in the spring, letting contracts during the fall or winter. This campaign also must fail to a large extent unless definite action is taken very soon by Congress concerning the federal road bill.
>
> With the passing of such a bill and an assurance to the states of continued aid from the federal government, it would seem to be perfectly practicable for them to complete at once a tentative program of road construction and begin immediately thereafter the preliminary grading of the roads selected for early construction; which grading can, over a large part of the country, be continued through the winter, with the exception of a few weeks of severe weather in the northern states. In addition to grading, the opening of gravel and sand pits and stone quarries and the crushing of the stone and distribution of these various materials along the highways for next year's use could proceed during the fall and most of the winter, and thus employment be given to considerable numbers of unskilled and semi-skilled men in all sections of the country.

Award of Costs to Municipality

In New Jersey, at least, it has not been the practice to award costs to a city when a decision in its favor is rendered in the case of a suit brought against it, although costs are frequently awarded to private parties under similar conditions. Recently the Jersey City Water Co. brought suit against Jersey City to recover $500,000 withheld by the city under the terms of a contract for water supplied. Following a decision of the court in favor of the city, the corporation counsel asked the court to allow a counsel fee and Vice-Chancellor Lewis awarded the city $3,000. This money is to go, we understand, to the city treasury and not to the corporation counsel or other legal consultant of the city, and the object in asking for it was chiefly to warn corporations that if they brought unjustifiable suits against the city they would be compelled to pay for doing so.

Water Works Finances, Labor and Meter Rates

Tabulation of supplementary data from cities in all parts of the country relative to meter rates, labor, operating costs and the financial difficulties of present conditions.

In our issue of June 4 of this year we published a table giving data furnished by several hundred water works superintendents in reply to a questionnaire sent by us. A number of replies arrived too late for that issue and belated ones continued to reach us up to the middle of September; but we assume that they are now all in, and are publishing this week a supplementary table giving these later replies.

In the June 18 issue we gave a summary of that part of these data referring to the methods employed by the several departments and companies in meeting cost increases. Further information on this point will be found in these supplementary data; and these and other features we expect to review in a subsequent issue.

WATER WORKS FINANCES, LABOR AND METER RATES

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft.; g-per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Alabama:											
Prattville	M	$1.25	10	$2.50	10	$2.50f per quarter	same	....	....	Funds from city treasury	No
Arizona:											
Phoenix	M	3.00	8	2.50	8	.12½g	.12½g	....	....	....	Distribut'n mains not kept up
California:											
Benicia	P	4.00	8	2.50	8	.60-.35g	same	$238.00	$233.00	Drawing on surplus	No
Chico	P	4.00-5.00	8	2.25-2.50	8	.22-.12f	.11¼-.15f	....	....	Cutting dividends, etc.	No
Eureka	M	4.50	8	2.50	8	.24f; .32g	.30f; 40g	.12½	....	Drawing on surplus	No
Modesto	M	5.00	8	3.00	8	.15g	same	45.00	same	Proceeds of water fund	No
Monrovia	M	4.00	8	....	8	1.00-.05f	.50-.05f	....	....	Funds from treasury—bond issue	....
Pacific Grove.....	P	3.00-3.50	9	2.25	9	1.10-0.25f	.30-.21f(a)	229.00	201.00	....	....
Porterville	..	4.00	8	2.50	8	.12½f; 16 2-3g	.18f; .25g	17.50	15.00	....	No
San Francisco ...	P	5.00	8	2.50	8	.24-.18f	flat rate	160.00	110.00	Installation of meters and increase in business	No
Santa Paula	P	3.50	9	2.00	9	.07½f	.07½f	....	....	Increasing sales	No
Tulare	M	4.00	8	2.00	8	.10g	.10g	710.00	680.00	Cutting force of employees	Fallen behind
Upland	P	4.00	8	3.00	9	1.00-.10f	1.00-.10f	....	....	More consumers	No
Colorado:											
Delta	M	2.80-3.50	8	2.00-3.00	8	.15g	1.00-.05g	12.40	....	Increased income—more consumers	No
Fort Collins	M	3.20	8	2.40	8	.20g	.15g	....	....	Bond issues	No
Greeley	M	3.50	8	....	..	.20-.06g	....	33.85	....	Raise in rates	No
Monte Vista	M	2.80	8	2.25	10	....	....	....	....	....	....
Montrose	M	3.20	8	4.00-4.50	11	.30-.10g	same	....	....	Curtailing expenses	....
Connecticut:											
Groton	M	.50	8	.30-.40	8	.25g	.25g	50.00	42.00	....	No
New Britain	M	.35	9	.17 4-9	9	.10f	.10f	....	....	....	No
S. Manchester ...	P	4.05	9	2.00	10	.20 less 10%f	25 less 10%g	119.00	....	....	No
Waterbury	M	4.00	9	3.00	9	.12-.15½f	.10-.15g	....	....	....	No
Windsor	M	3.60	9	1.75	9	.25gf	.25f	89.40	80.40(b)	Economy, cutting force	No
Winsted	..	3.00	9	2.00	9	.04-.09g	same	....	....	Reducing help, no extensions	No
Delaware:											
Laurel	..	2.00-2.50	10	1.25-1.50	10	1.00g	.50g	1,000.00	500.00	Increasing rates	Yes
Florida:											
De Land	M	3.00	9	1.50	9	.11f; .15g	.15g	....	....	Raising rates	No
Jacksonville	M	2.60	8	2.00	9	.08-.04f	.08-.04f	10.13	9.44	....	No
Ocala	M	1.75	9	1.25	9	.12½f	.20f	100.00	....	....	No
St. Augustine ...	M	2.50-2.75	8	1.50	8	.06f	.06f	....	....	Funds from city treasury	No
Georgia:											
Gainesville	M	2.00	10	1.25	10	.25g	.15g	55.70	....	Increasing rates	No
Savannah	M	2.50	8	1.50-1.75	8	.90f; .12g	.90f; .12g	15.00	30.00	Funds from city treasury	No
Idaho:											
Coeur d'Alene ...	P	3.40	8	2.50	10	.10-.40g	same	....	....	Cutting force, drawing on surplus, increase in population	....
Illinois:											
Bloomington	M	3.90	8	2.50	8	.50-.15g	....	117.00	92.00	Raising rates	No
Evanston	M	4.40	8	3.50	8	.12-.05½f	same	....	....	Operating at small deficit	Yes
Harvard	M	4.00	9	3.00	10	.37½f	.37½f	70.00	70.00	....	....
Morris	M	4.50	9	3.00	10	.20g	.20g	....	....	....	Somewhat
Normal	M	3.00	10	2.50	10	.26f; .35f	.18f; .25g	....	....	Funds from city treasury	No
Indiana:											
Greensburg	P	4.00	10	2.75	10	.12-.35g	.15-.35g	.19 per 1,000	.12	Cutting maintenance and dividends	Yes
Lafayette	M	95 per mo.	..	$85 per mo.	....	.25g	.20g	68.20	43.60	Increased rates	No

*Where rates are on sliding scale, the highest and lowest are tabulated when reported. a—1916. b—1915. c—1917.

Water Works Finances, Labor and Meter Rates

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft.; g-per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Indiana—Continued:											
North Vernon ...	M	3.00	10	2.50	10	no meters	....	$47.20	$20.92	Drawing on surplus and reducing force	Very little
Union City	M	.35	9	2.00	10	.15-.06f	.10-.06f	....	....	....	No
Iowa:											
Des Moines	M	4.05	9	2.00	9	.30-.10g	same	74.99	74.37	Rate increase	Yes
Fairfield	M	.35-.40	8-10	.25-.30	10	.53 1-3-.18g	.10-.12½g	....	....	Increasing rates	No
Hawarden	M	...	..	2.50	10	.35-.10g	.....	....	....	....	No
Kansas:											
Beloit	M	.50	8	.25	8	.40-.15g	.25-.10g	80.00	....	Increasing rates	No
Neodesha	M	3.60	8	....	..	.15g	flat rate	....	....	....	Yes
Louisiana:											
New Orleans	M	.39-.45	8	.25-.32	8	.10-.07g	same	....	....	From surplus	No
Ruston	M	2.00	10	1.50	10	33 1-3-.10g	.25-.10g	....	....	....	Yes
Maine:											
Farmington	M	3.00	9	2.00	9	....	....	....	....	....	No
Houlton	M	3.00	9	2.00	9	.35g	same	17.00	17.00	....	No
York	P	3.50	8	2.50	9	no meters	.....	....	....	....	No
Massachusetts:											
Clinton	M	4.50	8	2.00	18 weekly	.25-.06½f less 15%	.25-.06½f less 10%	....	....	....	No
Dalton	M	...	..	....	....	no meters	.....	gravity	....	....	No
Hudson	M	4.25	8	2.50	8	.25f	.....	101.00	19.00	Reducing force	No
Lenox	P	4.00	9	2.75	9	.35g	.25g	....	....	Raising rates	No
Manchester	M	4.80	8	3.20	8	.20f	.20f	....	....	From treasury	No
Medway	M	4.00	8	2.00	9	.30f	.30f	....	....	....	....
Pepperell	M	3.50	8	1.75	8	.45g	.40g	102.92	66.70	....	No
Sutton	P	3.20	8	1.75	9	1.00-.50g	same	....	....	....	No
Swampscott	M	5.00	8	3.00	8	.30f	.40f	....	....	Increased rates	No
Winthrop	M	4.00	8	2.50	8	.15f; .20g	same	....	....	Reducing costs and help	No
Michigan:											
Belding	M	3.50	9	2.00	10	.15f	.11f	....	.07	From city treasury	No
Boyne City	M	20 per wk.	10	1.75	10	.15g	.15g	....	....	....	Yes
Lansing	M	.40-.50	9	.20-.22½	9	....	.....	....	....	Increased rates, bond issue	No
Marshall	M	.50	9	.40	9	10-.20g	same f	....	....	....	No
Pawpaw	..	4.00	10	2.50	10	16-.18g	.12-.16g	....	....	....	....
St. Clair	M	4.50	8	3.00-3.50	10	.12½-.05g	same	7.00	2½	Surplus and city treasury	Yes
Traverse City ...	M	4.00	10	3.00	10	.06f	same	....	....	From earnings	No
Yale	M	4.00	10	.27½-.80	10	.15-.05f	same	....	....	Raising rates	Yes
Minnesota:											
Detroit	M	3.00	10	2.50-3.00	10	.25f	same	....	....	Raised rates	No
Ely	M	4.75-5.00	8	3.00-3.50	8	.25-.05f	.....	....	....	....	No
Mankato	M	3.50	10	2.00	10	.09-.045f	same	91.03(c)	....	City funds	Yes
Moorhead	M	4.00	8	2.00 3.25	9	.40-.05f	same	....	....	Increased consumption	No
Worthington	M	.30-.40	10	.30-.40	10	.30g	same	....	....	Bond issues, revenue from plant	No
Mississippi:											
Brookhaven	M	2.00	10	3.00	10	.30-.20g	.20-.15g	.07	.04	Increased rates, funds from other departments	No
Greenwood	M	1.50-2.00	10	1.25-1.50	10	.27-.08g	flat rate	25.00	....	Incr. rates—reducing consumption	Somewhat
Missouri:											
De Soto	M	.40	8	.20	8	.50-.11f	.25-.08f	....	....	Raising rate	Yes
Fulton	M	3.20	8	2.00	10	.30f; .40g	.25f; .33 1-3 g	....	....	Drawing from surplus and increasing rates	No
Kansas City	M	4.40	8	2.00	8	.17-.678f	.17-.825f	70.87	55.49	Drawing on surplus and reducing free consumption	Yes
St. Louis	M	.35-.58	8	.25	8	....	.....	57.26	31.76	Drawing on surplus, cutting force	No

c—1917

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Drive Small Earth Tunnels—II*

Use of poling boards and bulkheads. Enlarging cross section. Shield method, air lock, lining, ventilating.

Small headings about 6 feet wide and high can be driven through very treacherous material like fine, loose, dry sand or gravel with ordinary methods and timbering, supplemented by the use of poling boards. These are generally short pieces of narrow 2-inch planks, that are driven horizontally as far as possible into the earth in advance of the excavation.

For the roof of the tunnel, they are driven over the top of the last timber cap that is set and are inclined upward very slightly and are hammered or jacked forward as fast as the excavation progresses so as to penetrate a little beyond the excavation and seal the latter as much as possible. They are usually made a little longer than the distance between the bents, and the forward end is supported on the top of the next bent above a second series of poling boards that is started next to the cap timber and driven between it and the preceding set of poling boards so that the latter always resemble successive courses of overlapping shingles.

SIDE BOARDS

When the ground is very bad there is a tendency for the vertical sides of the drift to fall inward, and poling boards, similar to those in the roof can be driven on the exterior of the vertical posts. Often, however, horizontal longitudinal side boards can be successively set outside the posts without driving, breaking joints on post centers, as excavation proceeds. In either case it may be necessary to brace apart the bottoms of the vertical posts by horizontal struts at or below the floor level.

This precaution serves to resist unbalanced horizontal pressure on the sides of the tunnel, that in some cases becomes very heavy, as for instance in small headings drifted through blue clay under Boston harbor, where the material swelled by exposure to the atmosphere and exerted a pressure so heavy as to force the longitudinal timbers ½ inch into the faces of the vertical posts that they separated.

BULKHEADS

If the soil is very loose or unstable or if there is a heavy flow of ground water in the stratum excavated, it may be necessary to reduce the exposed surface of the heading to the minimum, which can be done by the use of transverse bulkheads consisting of horizontal transverse boards set, from bottom up, across the heading against the vertical or offset stakes and braced back to the assembled timbering by horizontal and inclined struts. The boards can then be removed one at a time from the top down, allowing the miners to withdraw small quantities of unstable earth or sand from under the ends of the roof boards, allowing the latter and the side boards, from the top down, to be advanced to correspond with the excavation and gradually working down with the latter from the roof to the floor of the tunnel.

Sometimes there is so much ground water or the soil runs so easily that it is also necessary to keep on hand a quantity of hay, straw or its equivalent to force through any cracks or cavities that may appear.

ENLARGING THE CROSS SECTION

If it is necessary to give the tunnel greater width than that of the original drift it can be done by widening the latter on one or both ends. If the ground is good this can be done without interfering with the original roof boards or timbering and additional posts and caps can be set as required to support the roof extensions. With loose ground it may be necessary to excavate under the protection of poling boards, driven as described for the roof except that in this case the boards will have to be supported on beams parallel with the tunnel axis.

In tunnels more than 10 to 12 feet wide, such excavation is usually accomplished by standard methods known as the crown bar methods, subject to modifications, and should be handled by experienced miners. Where the width or height of the tunnel is greater than can advantageously be excavated in a single operation it is frequently advantageous to excavate earth in a narrow transverse segment and install timbering to support the entire roof and afterwards continue the excavation to the bottom of the tunnel floor, replacing the vertical posts with longer ones or underpinning or blocking them as the work progresses. When drifts on both sides are carried down to the full depth of the tunnel excavation and are connected by transverse excavation close to the roof, the earth subsequently excavated between the longitudinal side drifts is called the dumpling, and is handled much more easily and rapidly than that excavated in the drifts.

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*Part I—Preliminaries, comparative trenching and backfilling, pipe tunnels, drifting, excavating, mucking and timbering was published Sept. 24.

SHIELD METHODS

A long tunnel in very loose, treacherous ground, especially if it is to be provided with a permanent iron, steel, or brick lining, may often be advantageously excavated by the shield method, which generally, although not necessarily, involves a circular cross section. In this case the shield consists of a riveted steel cylinder with a diameter just sufficient to give clearance over the outside of the finished permanent lining and of a length usually somewhat longer than its diameter. The forward end of the shield is usually reinforced by stiffening plates and braces on the cylindrical cutting edge. The whole forward end may be closed by a vertical transverse diaphragm having openings in it that can be closed by movable doors.

A rigid annular framework in the rear of the shield provides support for a number of circumferential horizontal hydraulic jacks that can be made to react against the forward end of the finished lining, which must always project a short distance inside the rear end or tail of the shield. The shield being put in position concentric with the axis of the tunnel is advanced by operating the hydraulic jacks simultaneously with or immediately subsequent to excavation through the openings in the forward end.

As fast as the shield advances a distance equal to the length of one section in the segmental tunnel lining, the latter is assembled in place inside the tail of the shield, the jacks replaced with bearings against the completed lining, and operations repeated, thus enabling the workmen to be always completely protected above, in front and on the sides and bottom of the headings by the movable steel shield telescoped over the forward ends of the lining.

The shield method is used for the excavation of tunnels of all diameters from the smallest to the largest, and is particularly advantageous in very wet, soft ground, being almost always used for subaqueous tunneling in mud, sand, clay, gravel or the like. It can be used to advantage in some loose, dry materials, and is almost indispensible where there is a great flow of water or soft material. In such cases it is generally accompanied by pneumatic pressure which, so long as it is properly maintained, excludes the water. Shields are sometimes used for the roof alone, but in that case it is for tunnels of considerable width and the side walls are usually built in drifts in advance of the shield.

AIR LOCK

In order to apply the pneumatic pressure it is necessary to install an efficient air compressor plant with a reserve machine, and to provide a substantial bulkhead and air lock at the entrance of the tunnel. The bulkhead must be strong enough to resist heavy unbalanced pressure, and be sealed airtight to the permanent lining of the tunnel. The air lock must be adapted for the transmission of all men, plant, supplies and materials needed in the tunnel and for exit of excavated material.

Usually the air lock is a riveted steel cylinder about 6 feet in diameter and 10 feet or more in length, with an airtight door at each end opening away from the heading and never both open simultaneously. The use of the pneumatic and shield methods combined enables tunnels to be driven through quicksand, through silt and through the very difficult combination of gravel, boulders, sand and water where the work could not be accomplished by any other method. Pneumatic tunneling is, of course, very slow and costly and requires special safeguards in case of accident. It should be used only under the direction of experienced men and often may be dispensed with during a large portion of the work and only applied for short periods or distances at critical times.

TUNNEL LININGS

For circular shield-driven tunnels, the lining almost always consists of segmental cast iron plates fastened together with internal flanges bolted on all four sides, thus forming a complete cylindrical shell, which is generally lined with concrete on the inside. There has recently been designed and used an equivalent lining made of pre-cast concrete blocks, which can be manufactured at the tunnel site, saving time and expense. Both the cast iron and the concrete segments are so heavy that they require special power appliances for assembling them in a tunnel, even one of small diameter. In some cases they can be replaced by much lighter and cheaper segments made of successive short wooden planks like scarf boards, cut to the curve and spiked together with staggered joints so as to make a continuous structure.

Circular tunnels excavated .with or without a shield may also be sometimes and advantageously lined in a manner similar to that using the cast iron segments, with pressed steel segmental plates corresponding to the cast iron plates, but very much lighter. These plates are generally left permanent in the ground and are then also usually covered with an interior coating of concrete, although it is possible that in some cases they might be removed where the ground is exceptionally strong.

Where tunnels are lined with concrete only, the latter may be placed in any convenient type of forms, including wooden forms built by the contractor himself and knocked down or advanced in sections according to circumstances. There are, however, standard forms carefully designed by experts and usually provided with adjustments and movable supports so that they can be easily stripped and moved ahead for more rapid and economical operation, that can be purchased or rented from regular makers. These are especially valuable for long tangents; on curves or irregular places, wooden forms are more likely to be suitable.

CONCRETING LINING

In small tunnels great difficulty is likely to be encountered from obstructions caused by attempts to deliver concrete in buckets or dump cars and by unloading the latter. If this method is unavoidable, special precautions must be taken to make the apparatus very compact and provide clearances for the other work to go on simultaneously. As the amount of concrete is comparatively small and the cost necessarily high, it is most generally found to be not only justifiable, but almost necessary to transport and deposit the concrete by pneumatic pressure, which can convey it many hundreds of feet through pipes from 4 to 6 inches in diameter, carrying it around curves and up or down through vertical or inclined sections of pipe. This process uses a considerable amount of compressed air, but is very convenient and efficient if properly handled.

LIGHTING AND VENTILATION

Tunnels are, of course, lighted by electric lamps and electric power is often used for pumping, hauling and other purposes, including drilling if small quantities of rock happen to be encountered. Care must be taken to keep the electric wires out of the way and when there is any danger of encountering explosive gases, special care must be taken to prevent explosion from electric sparks.

In some strata quantities of poisonous and explosive gases are encountered, which are often colorless, tasteless and odorless and are therefore very difficult to detect. These gases are usually heavier than air and settle in the low places, where they may be retained for a long time and gradually accumulate and sometimes cause very serious or fatal explosions, fires or suffocations. In certain proportions the gases mixed with the air are harmless and in other proportions are highly explosive. Tests of the air in the tunnel should be frequently made from samples which are easily collected by bringing bottles filled with water into the tunnel and emptying them in various parts and then sealing them and delivering them for laboratory examination. When gas is detected it must be removed by thorough ventilation, which is best accomplished by forcing large quantities of compressed air into the heading and pumping out air from the rear part of the tunnel.

New Water Supply for Glen Ridge

At a meeting of the borough council of Glen Ridge, N. J., on September 13, the mayor announced that arrangements had been made and a contract signed for obtaining a new supply of water for the borough. The contract had been made with the Butler Water Co., the supply to come from Apshewa river, a tributary of the Pequannock below the point where Newark gets its water. The company had previously been obtaining its supply from the East Jersey Water Co. under a contract which expired some time ago. It is reported that the borough will pay the water company $50 per million gallons for the water, and will pay the city of Newark $35 per million gallons for transporting it across that city from the mains of the Butler Water Co., and in addition will pay the East Jersey Water Co. $15 per million gallons as a stand-by charge for maintaining arrangements for serving the borough in cases of emergency. The consumers of the borough will be charged 2½ cents per 100 cubic feet. Formerly the consumers were charged 2 cents.

The borough has been seeking to obtain a new supply for several years. Test wells were bored with a view to using ground water but this was decided against and after negotiations with several companies the contract above referred to was arranged.

Proposed Subway and Tunnel for Habana Cuba

Plans for a subway system and tunnel for the city of Habana have been approved by the Cuban Railroad Commission, and the Cuba North & South Railroad Co. has been organized to promote this project. A representative of the firm of engineers in charge (Sr. Serafin Sanchez Govin, No. 62 Villegas street Habana), holding full power of attorney to act for the Cuba North & South Railroad Co., is expected to go to New York in October or November to arrange for the necessary capital and invites correspondence regarding either the structural or the investment possibilities of the project.

Protecting Wood Piles from Teredos

Piles driven in the Pacific ocean at Fort Orford, Ore., are so rapidly injured by the teredos that they had to be replaced on the average of once a year, therefore about 125 fir piles about 50 feet long that were driven last season to a penetration of about 20 feet in very hard clay that required previous blasting were enclosed below low water level with a casing of 14-gage Armco corrugated wrought iron cylinders, 24 inches in diameter, dipped in a special asphaltic mixture. After the piles were driven the protecting cylinders, riveted together at the site, were slipped over the tops of the piles and driven some distance into the bottom by 8-inch strokes of a 6,650-pound hammer, after which the annular space between the pile and the jacket was filled with concrete.

$10,000,000 Pipe Line to Be Constructed in Mexico

A concession has been granted to C. E. Yerby, Los Angeles, for the construction of a $10,000,000 pipe line to follow the route of the Puerto railroad from Puerto, Mexico, on the gulf coast, to Salina Cruz on the Pacific coast. Work will be immediately commenced on the construction of a 10-inch line, which will be completed about two years from now and will be followed by other lines, at a total cost of about ten million dollars. One half of the total capacity of the line will be operated under the Mexican Federal legislation governing common carriers and the remainder of their capacity will be subject to contract by the operating company. By the use of this line the cost of oil will be cheapened for consumers in Mexico, in the Pacific states oil will be more available for fuel stations, and a saving of 11 days' time will be made in the transportation of oil across Mexico and of 2,300 miles in the distance required for its transportation through the Panama Canal. The air line distance between the pipe line terminals is about 135 miles.

NEWS OF THE SOCIETIES

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventh annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 3-7 — AMERICAN ELECTRIC RAILWAY ASSOCIATION. Atlantic City, N. J.

Oct. 5-7 — SOCIETY OF INDUSTRIAL ENGINEERS. National convention. Springfield, Mass.

Oct. 8—BROOKLYN ENGINEERS' CLUB. Dinner. Chamber of Commerce.

Oct. 11-14 — INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention. Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 11-14—AMERICAN ASSOCIATION OF PORT AUTHORITIES. Annual meeting. Seattle, Wash. Secretary, M. P. Fennell, Jr., 57 Common St., Montreal, Canada.

Oct. 12-14 — LEAGUE OF KANSAS MUNICIPALITIES. Annual convention. Lawrence, Kans. Secretary, John G. Stutz, University of Kansas.

Oct. 20-21 — CITY PAVING CONFERENCE. Engineers Club of Philadelphia, 1317 Spruce St., Philadelphia. H. E. Hopkins.

Oct. 20-21—OHIO STATE CONFERENCE ON CITY PLANNING. Annual conference. Columbus, Ohio. Secretary-treasurer — Charlotte Rumbold, Chamber of Commerce Building, Cleveland.

Oct. 24-28 — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, St. Petersburg, Fla.

Oct. 31-Nov. 5 — NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-16—CITY MANAGERS' ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. **New York City.**

Nov. 16-18 — NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

Nov. 17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Society of Naval Architects and Marine Engineers. New York.

Nov. 17-18—SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS. New York.

Dec., 22-23—KANSAS ENGINEERING SOCIETY. Hutchinson, Kan.

CANADIAN HIGHWAY ASSOCIATION

In order to encourage the promotion of a continuous highway across the Dominion from Cape Scott at the northern extremity of Vancouver to the most easterly extremity of Nova Scotia, the Canadian Highway Association was formed last month. John L. Beckwith was elected president; Lord Byng, Hon. Arthur Meighen and Premier Oliver asked to act as patrons; Samuel Hill of Seattle, international good roads enthusiast, was chosen as honorary president; and F. R. McD. Russell of Vancouver, Reeve Sam J. Drake of Oak Bay, and Alderman A. E. Todd of Victoria made vice-presidents.

ONTARIO TOWN PLANNING AND HOUSING ASSOCIATION

A convention of the Ontario Town Planning and Housing Association is planned for the latter part of October at Massey Hall, Toronto, at which a large number of delegates will be in attendance from all parts of Ontario. At the convention it is expected that several experts of the Chicago City Planning Commission will deliver addresses; and papers will be read by Dr. H. L. Brittain of Toronto and G. W. McLaughlin of Oshawa. All problems which affect growing municipalities will be taken up, and the Dominion and Provincial governments asked for aid in the work.

INTERNATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONS

The eighth annual meeting of the International Association of Industrial Accident Boards and Commissions was held in Chicago on September 19-23 at the Hotel La Salle. The convention opened at two o'clock Monday afternoon with Charles S. Andrus, president, as chairman. Addresses of welcome were delivered, and the subject "Administrative Problems Under State Funds" discussed. On Tuesday morning an accident prevention meeting was held; there were also interesting meetings on Wednesday and Thursday, at which the society was addressed by well-known speakers; and on Friday morning the report of the Committee on Resolutions was read.

NATIONAL SAFETY COUNCIL

The tenth annual congress of the National Safety Council was held at the Massachusetts State House, Boston, Mass., on September 26-30th. As has been the custom at past congresses, the delegates from the various industries met in separate sectional meetings with others of their own group for special problems relating to their own industries, as well as at the general meeting, in which the representatives of all industries joined. These special meetings were held for the automotive, chemical, construction, electric railway, metal and pulp, public utilities, rubber, steam railroad, textile and woodworking industries. There were also meetings of the education, engineering, health service, public safety, and women in industry sections of the National Safety Council.

SEATTLE CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS

The Seattle chapter, A. A. E., entertained C. E. Drayer, national secretary of the A. A. E., at its meeting on the evening of September 16th. This meeting was preceded by an informal dinner at the Elks' Club with Mr. Drayer as guest. At the meeting Secretary Drayer spoke on "The Broader Field for Engineering Service."

MEETING OF WORLD'S ENGINEERS

Delegates from various engineering societies in England, France and America will meet at the Engineers' Club, New York City, on the evening of October 10th to "establish a new international contact which shall promote concord among the English-speaking countries, advance the science of engineering and work along conservative lines for the establishment of international peace." The meeting will also celebrate the return of the American engineers who went abroad to confer the John Fritz medal upon Sir Robert Hadfield of London and Eugene Schneider of Paris. Invitations to this meeting have been extended to many men prominent in public life, including Herbert Hoover, Viscount Bryce and Charles E. Hughes.

DULUTH ENGINEERS' CLUB

G. H. Herrold, managing director of the city planning board of St. Paul addressed the regular meeting of the Duluth Engineers' Club held on September 19th. The meeting was opened by an informal dinner at the Commercial Club, after which the regular meeting was held. Mr. Herrold discussed the questions, what city planning boards are, how they are appointed, what authority they have and the work that has been done in general; all of which, though with special reference to the work of the St. Paul board, was of broad general interest.

WESTERN SOCIETY OF ENGINEERS

The Western Society of Engineers was addressed on September 12th by A. R. Hirst, state highway engineer of Wisconsin, on "Developing a System of Highway Transportation to Serve the People of a State"; on September 19th by Arthur E. Morgan, former chief engineer of the Miami Conservancy District on "Dayton Flood Control," and on September 26th, chief engineers' night, by C. A. Morse, A. S. Baldwin, H. R. Safford, C. F. Loweth and E. J. Lee on their experiences of the different railroad systems with which they are connected.

ALLIED ENGINEERS' ASSOCIATION

The Allied Engineering Association, Charleston, S. C., has announced for the season the following papers: Oct. 17, "The Auto Truck—Its Use in Construction Work," by Lt.-Col. Eugene Kelly; Dec. 19, "Rebuilding Filter Plant, Charleston Water Department," by Francis D. McDowell, Jr.; Jan. 16, "The Engineer and the Financier," by E. H. Pringle, Jr.; Feb. 20, "Concrete Roads," by James W. Martin; March 20, "Construction of Bridge Piers for the New Santee River Bridge," by J. Bryce LaBruce; April 17, "Railroad Problems," by J. P. Walker; May 15, "Paving of City Streets," by J. H. Dingle.

The officers of this association are: President, J. E. Gibson; vice-president, W. L. Whitescarver; secretary and treasurer, T. A. Burbridge.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

HYDRAULIC DREDGES

The hydraulic dredges for river, harbor and canal excavation and land reclamation, designed and constructed by the Bucyrus Company, are claimed to be manufactured by the only firm in the world that has specialized in the design and construction of the heavier high-power hydraulic dredges and that has built more of that type than any other manufacturer. For 40 years this company has studied the performance of dredges in all kinds of operations and claims to develop the most durable and efficient machinery units for this class of work.

The construction of the New York State Barge canal gave the Bucyrus Company opportunity to demonstrate their theories, and the five 20-inch hydraulic dredges of their make that were used on that work successfully handled cemented gravel and small boulders previously considered impossible for a dredge of this type. Since then, this heavy type of dredge has been steadily developed and improved. As an illustration thereof, the cutter on one of their large hydraulic dredges has been operated under 600 electrical h. p., which was 100 per cent in excess of the normal rating of its motor.

Bulletin H-101 recommends the use of the hydraulic dredge on improvement and construction work where the material encountered does not contain boulders that require blasting or are too large to pass through the pipe and where a suitable spoil area can be found within the radius of 1 mile from the point of excavation, although there are records of these dredges pumping materials through a line more than 1,000 feet long to an elevation of 90 feet with the aid of two booster pumps.

The casing of the standard horizontal single suction type pump is a single casting designed for maximum strength, durability and ultimate economy, with thickness up to 5 inches in the zone of maximum wear. The suction pump has a renewable casting bolted to the front head. All parts of the pump which come in contact with the dredged material are made of special nickel chrome steel which has proven very serviceable in this class of work. The shaft is fitted with a renewable sleeve where it passes through the water sealed stuffing box.

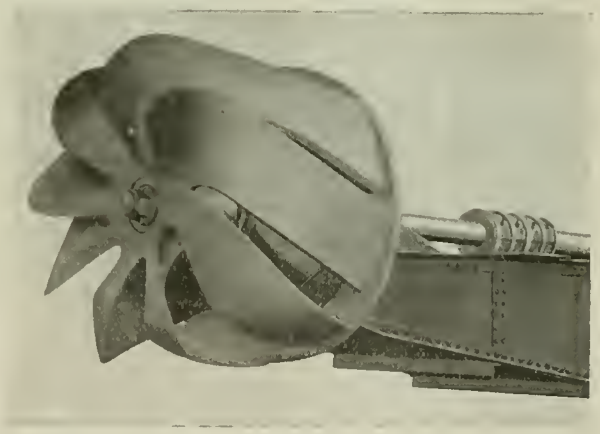
For suction and discharge piping, nickel chrome or high carbon steel castings from ¾ inch to 1 inch thick are recommended and are designed to include a minimum number of elbows and bends.

It is recommended that a cutter head with five to eight spiral blades be installed with every suction pipe. It is mounted together with a driving shaft and the suction pipe on a plate girder ladder suspended by wire rope tackles from a bow jib or A-frame mounted on the deck.

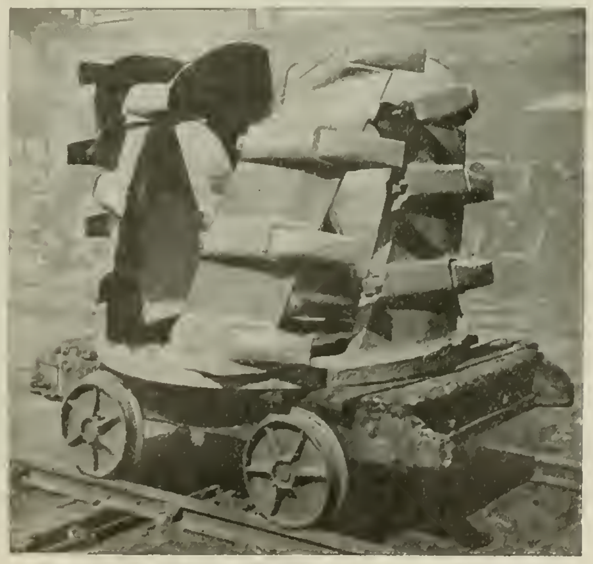
A 5-drum winch is provided for hoisting the ladder and the spuds and for swinging the dredge. Each drum is bronze bushed and mounted loose on its shaft and is engaged by means of a friction clutch of the outside band or internal expansion type and actuated by steam or air cylinders. The dredges may be designed to operate with steam or electric power.

The bulletin contains a list of data necessary to permit a satisfactory estimate on a dredge. It is illustrated with halftone engravings of a number of large hydraulic dredges installed on important operations.

THE CUTTER HEAD IN ACTION



HEAVY 8-BLADE CUTTER HEAD DESIGNED FOR HEAVY DIGGING



TYPE OF CUTTER HEAD USED FOR EXCEPTIONALLY HEAVY DREDGING WHERE MATERIAL IS EXTREMELY COMPACT OR BOULDERS PREVAIL

INDUSTRIAL NOTES

EXCAVATOR AND PORTABLE ROCK CRUSHER AT THE GREEN LAKE COUNTY GRAVEL PLANT, MANCHESTER, WIS

PORTABLE GRAVEL PLANTS FOR HIGHWAY WORK

Gravel for the construction of 26 miles of highway in Green Lake County, Wis., has been derived from local pits by the use of two portable plants, each of them including one 20-h. p., Minneapolis Steam Tractor, one Allis Chalmers Portable Gyratory Crusher, one bucket elevator, one Smith excavator and loader, and two 10-yard material bins and screens.

The first plant was installed near Manchester in a deposit of excellent gravel, which did not need screening and was delivered by 5 Quad and 4-wheel drive trucks with each crusher that handled an average of 125 to 137 yards daily, an amount below the capacity of the plant. After producing about 10,000 yards of sand and gravel the entire plant was removed without difficulty to another pit and resumed operations there.

EXCAVATING 10,000 YARDS OF GRAVEL FROM THE MANCHESTER PIT WITHOUT MOVING POSITION OF EXCAVATOR

The efficiency of this plant was so satisfactory that a duplicate plant was installed at Dalton, about 7 miles away, and excavated about 4,000 yards of gravel, after which it was moved 100 yards to another pit, containing about 10,000 yards.

The standard excavator and loader machine, operated by its own 18 h. p. gasoline engine, is installed at the edge of the pit and at an elevation of about 4 feet above the surface of the ground, operates a dragline excavator bucket with a radius of 150 feet. The excavator delivers to a stone crusher and the product of the latter is elevated by a bucket conveyor to the screens or direct to the storage bins, both crusher and conveyor being operated by the same tractor that hauls the plant from place to place as required. With a force consisting of foreman, excavator operator, crusher man, tractor operator, loading bin man and two or three men in the pit, a production of about 200 yards per day is attained.

THE SECOND PLANT AT DALTON, ABOUT 15 MILES FROM MANCHESTER

Similar plants are being operated by other counties in Minnesota, the advantages claimed being small investment, low operating costs, minimum labor, portability, location of plant outside of the pit, loading of wagons and trucks on the surface of the ground rather than in the pit, applicability for small gravel deposits or combinations of several units to work large deposits and the ability of the excavator to plow, dig, haul and load any type of soil, thus enabling it to do its own stripping.

CHANGE OF NAME

The corporate name of the Snare & Triest Company, New York, has been changed to the Frederick Snare Corporation, which will continue the general engineering construction business with the same staff. This concern was organized in 1900, since which time it has completed more than 1,200 contracts in the United States, Cuba, the West Indies and South America, including piers, bulk heads, break waters, jetties, ferry terminals, bridges, reservoirs, pipe lines, elevated railroads, power plants, dams, tunnels, coaling plants and other important engineering constructions.

WOOD PRESERVATION BUREAU

The American Wood Preservers Association, with a membership of 37 or more, including several lumber companies and 15 creosoting or wood preserving companies, has established a service bureau to promote the use of wood properly treated to resist marine borers and insect attacks, and maintains the bureau at 1146 Otis Building, Chicago, to answer inquiries regarding the treatment of wood and the use of treated timber; to disseminate information on the preservation treatment of wood; to furnish reliable information on the durability of treated and untreated wood; to show where these materials have proved satisfactory; to give information on causes and remedies for deterioration of wooden structures, and to show how treated wood can be used economically when substitutes are being considered.

Harold B. Wood has been placed in charge of the New York office of the Jeffrey Manufacturing Co., of Columbus, Ohio.

The Clyde Iron Works Sales Co., of Duluth, Minn., has placed its Pittsburgh agencies with the John H. Carline Machinery Co. of that city.

PUBLIC WORKS.
CITY COUNTY STATE
A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.
Vol. 51 OCTOBER 8, 1921 No. 15

Sewage Treatment at Allentown

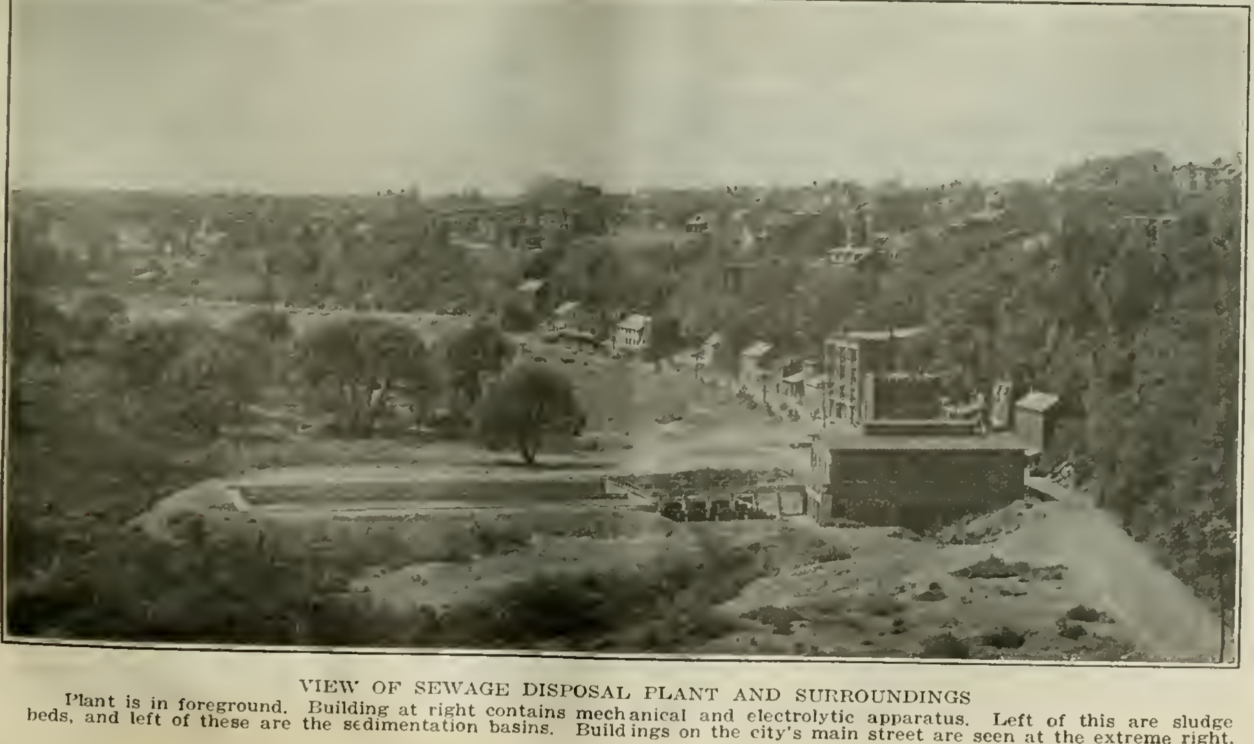
Located near main business section. Second municipal instillation of the "direct oxidation" electrolytic process, with sedimentation basins and sludge beds.

By H. F. Bascom

A sewage treatment plant went into service at Allentown, Pa., on July 27 of this year which is the largest and most complete of its kind yet constructed in the country and the second to be put into service as a municipal plant, although others have been operated as large-scale experimental plants. This plant is of the type known as the Landreth or "direct oxidation" process.

Allentown has grown rapidly from a population of 35,416 in 1900 to nearly 80,000 in 1920 and has enjoyed the distinction of being one of the cleanest and most sanitary of the smaller cities of the country. This, however, was in spite of the fact that not one line of sanitary sewers had ever been constructed in the city until 1920. The usual plan was for each house owner to excavate or drill a cesspool or "sink" (as they are called locally) to a few feet below the surface where a loose, porous limestone rock formation was generally encountered into which the sewage matters disappeared.

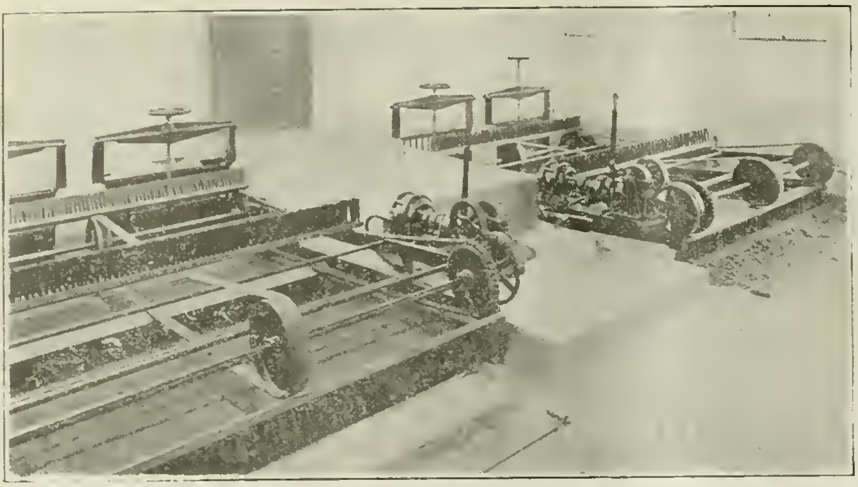
Several attempts were made to secure local legislation that would enable the city to construct a sewage disposal plant but these met with failure. Several consulting sanitary experts were engaged on different occasions, the latest of these being in 1908, when plans were prepared and presented to the state department of health for approval, which department granted the city, on July 27 of



VIEW OF SEWAGE DISPOSAL PLANT AND SURROUNDINGS

Plant is in foreground. Building at right contains mechanical and electrolytic apparatus. Left of this are sludge beds, and left of these are the sedimentation basins. Buildings on the city's main street are seen at the extreme right.

*City Engineer of Allentown



SCREENS AND BRUSHES

Screenings can be seen on the floor in front of the right-hand screen, where they are thrown by the brushes.

that year, a permit to construct the system, but no advantage was taken of this permit by the city. At one time a charter was obtained by a private corporation permitting the construction of a system and engineers were engaged to design and construct a system, but the strength of the opposition to private ownership of a sewerage system for the city or other reasons prevented the company from carrying out the project.

The writer, when serving a term as city engineer from April, 1903, to April, 1906, and as member of select council from January, 1910, to December, 1911, and again from the latter date to November, 1913, during two terms as chairman of the finance committee of city council, did his utmost to have plans prepared for the construction of a sewage disposal system. He is again (since February, 1918) occupying the position of city engineer and in the early part of 1919 he combed the whole field of possibilities for a successful or at least favorable type of system. A farm of 460 acres situated along the Lehigh river between Allentown and Bethlehem had been purchased for sewage disposal purposes at a cost of $125,000 and his first recommendation was that this be sold, which was adopted by city council and in November of 1920 a large corporation purchased it, paying $141,000. The plan finally adopted for disposal was that known as the "direct oxidation" or Landreth process, by which the sewage, after having been passed over a screen, is treated with a solution of lime and then passed through electrolizing units, on emerging from which all odor has disappeared and practically all of the bacteria, and the effluent compares favorably with the river water into which it is discharged.

The plant was located in an old building which had formerly been used as a pumping station by the water department and was still owned by the city but not used. It was located on the Little Lehigh river, within 1,500 feet of the main business center of the city, and immediately adjacent to a number of residences.

The building was altered and reconstructed to a considerable extent, both to better adapt it for the installation of the plant and also to improve the appearance both exterior and interior. In addition, the surrounding land, which was low and swampy, has been graded up and will be planted to sod and shrubbery with a view to giving an attractive appearance to the surroundings of the building and the construction of a park, $36,930 being paid the contractor, George H. Hardner, for the reconstruction of the building, of which about $4,500 is for the grading.

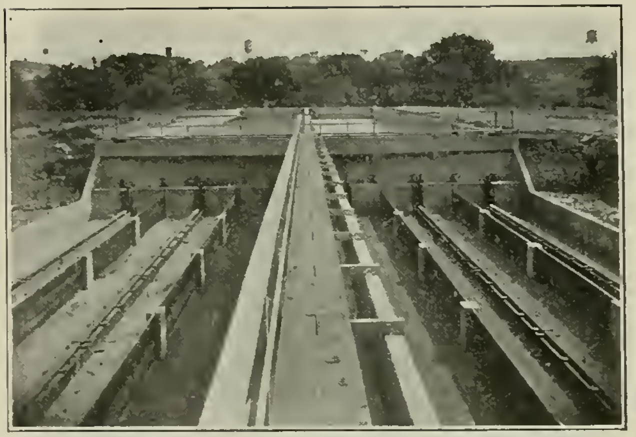
The road leading to the building falls below the hydraulic gradient of the sewer which it is necessary to maintain in order to operate the plant by gravity, and for a considerable distance each side of the plant the sewer mains leading to it act as inverted siphons, that coming from the west being an 18-inch cast iron pipe and that from the east a 24-inch cast iron. These unite into an 18-inch iron pipe which rises 15½ feet to the level of the horizontal screens. Under each line near the

BUILDING VIEWED FROM END OF SEDIMENTATION BASINS.

Tower at left contains lime storage equipment. Basin outlet in foreground center. Residences are shown directly opposite building.

riser is an 8-inch blow-off controlled by valves, these blow-offs leading to a sump under the disposal building. It is proposed that the sewage will ordinarily flow by gravity on to the screens, and be drawn off into sump only when it is desired to empty the inverted siphons for any reason or flush out sediment in them. For emptying the sump there are provided two 4-inch pumps, each with a capacity of 500 gallons a minute against a 20-foot head, each operated by a G. E. motor, and regulated by floats in the sump pit so as to operate first one pump and later, if the sump continues to fill, the second pump. In case of failure to operate, the pumps are connected with an electric alarm bell to call the operator.

The same contractor, George H. Hardner, also received the contract for laying these inverted siphons for installing the electrolyzing units, pumps and other piping, switchboards and other appurtenances; also for building the sedimentation basin and sludge beds. The apparatus inside of the building, which includes everything except the sediment tanks, sludge beds and channels and pipes connected with them, was sublet to the Municipal Disposal Company, which purchased the electrolyzing apparatus from the Direct Oxidation Process Corporation. The cost of the mechanical portions of the plant was $134,576 and that of the basins and beds was $33,443, of which amount $5,600 was for concrete piling for foundations. The inverted siphons cost about $53,000, of which about one half was for the pipe.

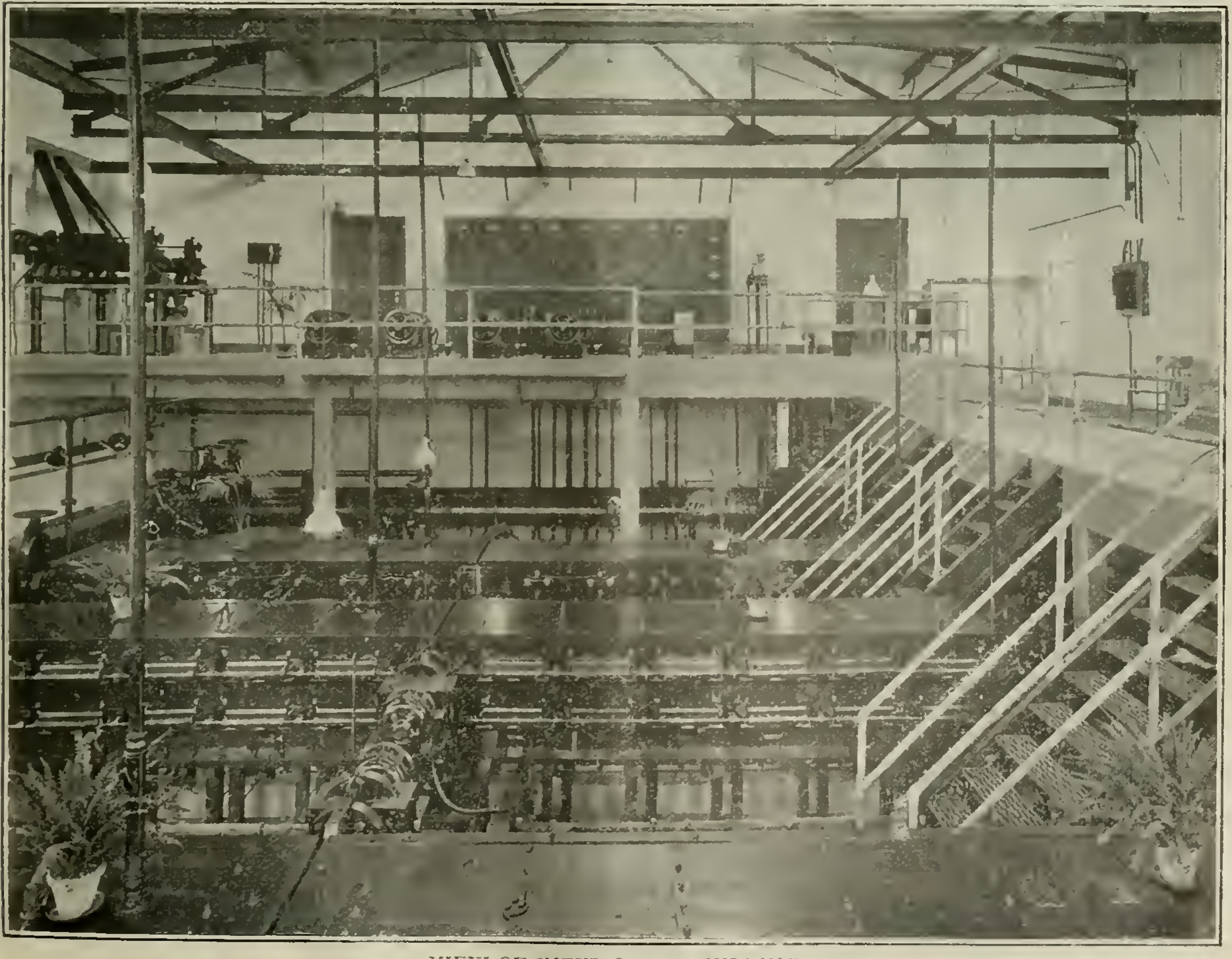


SEDIMENTATION BASINS AND SLUDGE BEDS

View taken from building. Walk in center rests on flume carrying effluent to basins. Sludge beds are in foreground.

MODE OF OPERATION OF THE PLANT

The sewage, on entering the plant, passes through a screen, is then dosed with lime and passes into one of the electrolyzing units. About



VIEW OF INTERIOR OF BUILDING

Electrolyzing units on the lower floor. Beyond these, at the right, the venturi meter, with its recording apparatus on the gallery above. On the gallery, at the right, the attendant's desk; in the center, the switchboards, one for each electrolytic unit. At the left, the lime feed apparatus.

a minute is occupied in passing through this unit, when the effluent is discharged into an open concrete flume which leads it to one of the two sedimentation tanks. From these tanks the effluent is discharged directly into the Little Lehigh river, which is only a few feet distant. The sludge collected in the bottoms of the sedimentation tanks is drawn off onto sludge beds, from which it will be removed and disposed of either for fertilizing or for filling in the low land near the plant. At present the amount of sewage is so small that its slow flow through the inverted siphon would tend to cause deposits therein, and it is allowed to flow by gravity to the sump and is pumped from this to the screens. There are two screens, two appliances for feeding lime, three electrolyzing units with room for a fourth for future installation, two sedimentation tanks and six sludge beds. In addition there is a Decarie incinerator for burning the screenings and a considerable plant for handling the lime.

The lime is dumped directly from the truck through an out-door opening onto a coarse screen which holds out any large lumps, these to be broken up by hand. From this screen it falls to the floor of the crusher room, where it is discharged into a Sturtevant crusher from which the discharge is to the boot of a bucket elevator. This raises the lime, broken into small particles, to a fifty-ton tank, where it is stored. From this tank it is drawn as needed into a Raymond pulverizer, where it is broken up into a fine powder, that which is sufficient pulverized being drawn up by a column of moving air into a "cyclone" collector and a tubular collector. From this it is drawn down into a hopper for use. From the hopper it is discharged through two pipes to the duplicate lime feeding apparatus, which can be adjusted to feed the pulverized lime at any desired rate into a small box where it is dissolved in treated sewage and discharged into the raw sewage just before the latter enters the electrolizing units.

The screens are located in a screen room 22 feet 6 inches by 21 feet 6 inches. They consist of 3/16-inch steel plates 8 by 8 feet with ¼-inch holes. The solid matter removed on these screens is brushed off onto the floor at the end of the screen by means of four brushes fastened on two chain belts which are run by sprocket wheels operated by an electric motor. Screenings are shoveled up at intervals as necessary and dropped through a manhole into the room below, where they are burned in a Decarie incinerator, coal being used for fuel.

The sewage as it goes to the electrolizing units passes through a Simplex venturi meter, which is provided with an automatic recorder which keeps a record of the daily flow of sewage.

Each of the electrolyzing units has a nominal capacity of one million gallons in 24 hours. These units are similar to those described in "Municipal Journal" for November 16, 1918, except for a few minor improvements. The room in which these are located, together with the piping and venturi meter, occupies practically the entire area of the building, the dimensions of which are 76 by 46 feet. The three are located on the basement floor. On two sides of the room is a gallery slightly above ground level, at which level are located the switchboard, lime feeding apparatus, operator's desk, etc. The incinerator and a furnace for heating the building are located in the basement.

The only opportunity for odor in the building, because the only place where the sewage is exposed to the atmosphere, is in the screen room. This is ventilated by means of a ventilator, but so far it has been necessary to use this only once or twice a day, generally when the pumps are first started after the sewage has been stored for nearly 24 hours in the inverted siphon pipes.

The sedimentation tanks are of concrete, each 150 feet long by 30 feet wide and from 7 to 11 feet deep. Channels are located in the bottom of each tank and covered with perforated plates, the channels to be used for drawing off the sludge onto sludge beds. A pipe is also provided for drawing off the supernatant liquid preparatory to removing the sludge.

This table shows that the electrolizing unit reduced the total bacteria by 99.3 per cent and the B. coli by 99.97 per cent. The total reduction by both this and the sedimentation basin was 99.95 per cent of total bacteria and 100 per cent. B. coli. While the retention in the sedimentation basin is, of course, much longer than it will be when the plant is running at its normal capacity of 3,000,000 gallons per day, the electrolizing units are operated at the rate of 1,000,000 gallons a day per unit, one unit being used only about two hours per day at present. The result obtained by the electrolizing unit may therefore be assumed to be the same as will be obtained when the plant is running at full capacity.

As stated, the plant is located within 1,500 feet of the main business street, this being possible because of the absence of nuisance and the small area required. The latter and the fact that a long and expensive trunk line to a distant disposal plant is obviated, and the ease of operation, all seem to be distinct advantages of this system. The plant is convenient to the center of the city and the railroad stations and can easily be inspected by officials from other cities, who will be welcomed at any time.

Road Machinery for Venezuela

The Venezuelan Commercial Agency in this country reports that the establishment of close diplomatic and commercial relations between Venezuela and the United States is likely to result in a great increase in road building in the former country, calling for the use of considerable numbers of steam rollers and other standard road building apparatus.

Macadam is the principal type of roadway built so far in the mountain regions, and natural dirt on the level plains of the interior. However, oil for sprinkling is now being used on these roads. A large number of steel bridges have been required and for the most part have been imported and erected by American concerns. "American enterprise is welcomed in Venezuela, which is adopting an extremely friendly attitude toward foreigners.

Highway Detours in Illinois

Well worked out scheme of signs for directing travel around roads under construction. Instructions to highway engineers and inspectors.

The Division of Highways of Illinois has issued a "Manual on Road Construction for Resident Engineers and Inspectors" which was prepared by B. H. Piepmeier, engineer of construction; the purpose of which is "to set forth briefly the requirements of the Department of Public Works and Buildings in the construction of various types of roads." This manual contains sixty pages of valuable instructions and suggestions, well classified and clearly stated, from which we may later excerpt some portions. Below we give the instructions relative to detours:

DETOUR AND BARRICADE SIGNS

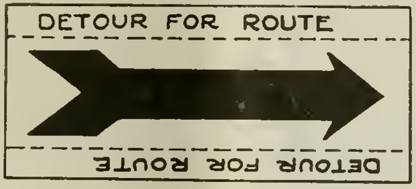
All detour, slow and barricade signs shall be erected and maintained by the engineer in charge of the road or bridge being improved. All signs necessary to guide the traveling public around any highway that has been closed for improvement shall be secured from your district engineer.

All signs erected shall be securely fastened to a solid background by means of paste or tacking completely around the margin at intervals of not more than three inches. If thin paper signs are supplied they may be pasted to a board background, if the heavy cardboard sign is supplied it will have been dipped in paraffin or shellac to protect it from the action of the weather.

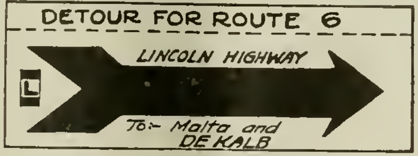
Slow Sign. The slow sign (Fig. 1) shall be erected on a post set in the outer edge of the shoulder about 400 feet ahead of the barricade. The top of the sign shall be about 4 feet from the ground line, the post supporting the sign shall not be smaller than a 2x4 and shall be set at least 2 feet into the ground.

Road Closed. The road closed sign (Fig. 2) shall be erected on two substantial posts set in front but independent of the barricade. The posts shall be at least 2 inches by 4 inches by 7 feet long and set two feet apart, and at least two feet into the ground at a point where they will not be disturbed by traffic. On the "Road Closed" sign you shall print carefully sufficient information to guide the traveling public around the road that is closed for improvement, i. e., N-2 mi.; W-3 mi.; S-2 mi. brings you back onto the road.

Detour Signs. A detour sign shall be fastened immediately below the "Road Closed" sign, with its arrow pointing in the direction of the detour. Detour signs shall be erected in such way that traffic going in both directions may readily follow the detour. There shall be at least two signs



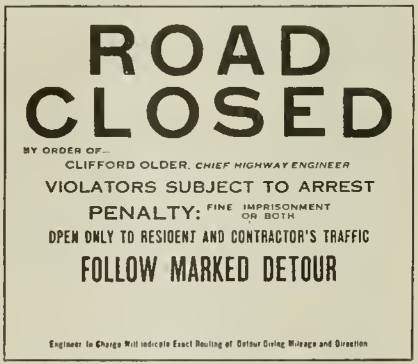
STANDARD DETOUR SIGN AS FURNISHED BY DEPARTMENT



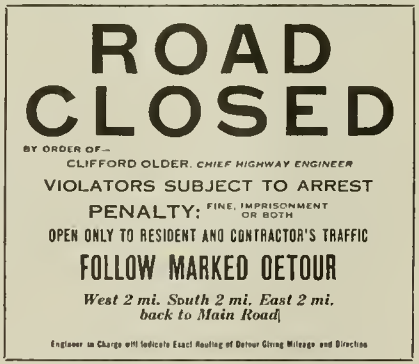
STANDARD DETOUR SIGN SHOWING ENGINEERS NOTATIONS BEFORE ERECTING

FIG. 3—STANDARD DETOUR SIGN

NOTE—Engineer in charge will indicate before erecting the sign, the Route number, name of Trail, its Emblem if the road has a name and emblem, the next town and County Seat or main City on the road.


ROAD CLOSED
BY ORDER OF—
CLIFFORD OLDER, CHIEF HIGHWAY ENGINEER
VIOLATORS SUBJECT TO ARREST
PENALTY: FINE, IMPRISONMENT OR BOTH
OPEN ONLY TO RESIDENT AND CONTRACTOR'S TRAFFIC
FOLLOW MARKED DETOUR
Engineer in Charge will indicate Exact Routing of Detour Giving Mileage and Direction

Road Closed Sign as furnished by Department


ROAD CLOSED
BY ORDER OF—
CLIFFORD OLDER, CHIEF HIGHWAY ENGINEER
VIOLATORS SUBJECT TO ARREST
PENALTY: FINE, IMPRISONMENT OR BOTH
OPEN ONLY TO RESIDENT AND CONTRACTOR'S TRAFFIC
FOLLOW MARKED DETOUR
West 2 mi. South 2 mi. East 2 mi. back to Main Road
Engineer in Charge will indicate Exact Routing of Detour Giving Mileage and Direction

Road Closed Sign showing Engineers notations

FIG. 1—STANDARD WARNING SIGN

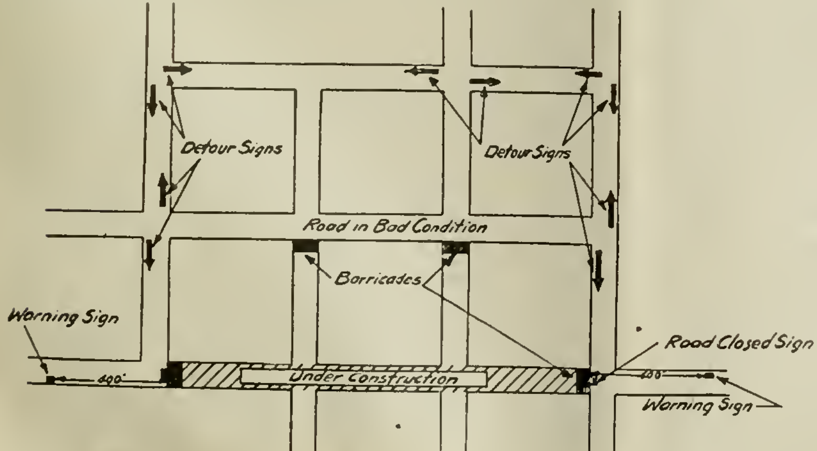
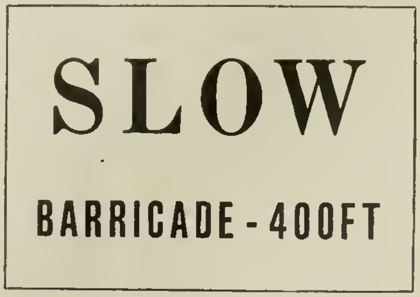


FIG. 4—MAP SHOWING POSITION OF BARRICADE AND DETOUR SIGNS



STANDARD WARNING SIGN FOR BARRICADES

FIG 2—ROAD CLOSED SIGN

at all cross or intersecting roads and a sign along the road at least every mile. If existing poles are not located in position desired substantial posts shall be securely set at the desired points and the "Detour" signs securely nailed to them. The post shall be set so that the traffic that is being detoured may readily see the sign and not fail to make the proper turn. Fig. 4 will serve as a guide in the location of the different signs.

Purchasing and Erecting. Unless otherwise instructed by your district engineer you will make a memorandum of the sign boards and posts needed to detour the work at all times during its construction. You will then go to the nearest lumber yard and secure sufficient lumber for the signs needed and get a receipted bill, which you may turn in at the same time you forward your expense account. The contractor will probably loan you the necessary tools to make and erect the signs. If extra help is needed hire a man and get a receipt for the amount paid.

Maintenance of Signs. From time to time determine the signs that are actually needed to detour the traffic around that portion of the road that is closed. Try and check all signs each day or at least twice each week to see that they are in place. No excuse will be accepted for not having all signs erected and maintained in such way that inconvenience to the traveling public will be minimized.

Maintenance of Detour Road. If the road on which you have chosen to detour traffic is in need of dragging or maintenance, get in touch with the local township commissioner and exert your influence to have the road dragged. It might be well to determine your detours as soon as you arrive on the job and consult the highway commissioner concerning their maintenance. This will give the commissioner a more active interest in the construction of the road and will result in his co-operation from the start.

BARRICADES

It is the duty of the engineer to see that the contractor puts up proper barricades, maintains them during construction and completely removes them from the site before final acceptance.

Barricades should be constructed in the following manner: Posts shall be erected at 5-foot centers entirely across the roadway and at least one line of 2 x 6-inch timber spiked near the top of the posts. The posts shall be 6 inches by 7 feet long, of sound material and set at least 3 feet into the ground. In case it is necessary to permit the people living along the road entrance through the barricade, opening shall be provided, preferably near the center of the roadway and a substantial gate erected. The entire barricade shall then be whitewashed or painted white. The contractor shall be required to see that the barricades are locked and that proper individuals are supplied with keys until the final completion of the road. The contractor may arrange with each property owner living along the road to provide his own key and padlock which may be attached to the gate. When this arrangement is made each padlock forms a link of the locking chain. If the barricade is to remain for any considerable length of time, such as through a winter, it shall be painted with black stripes.

Standardization of Water Works Brass Goods

At the time of the convention of the New England Water Works Association at Bridgeport a meeting was held of three committees on Standardization of Brass Goods for Water Works appointed by the New England Water Works Association, the American Water Works Association and the National Association of Brass Manufacturers, respectively. This committee on September 14, after a detailed discussion, unanimously adopted a report to be presented to their respective organizations.

This report contained twelve items. Some of those of most interest to engineers and superintendents required that all brass goods intended for underground service should be made of a standardized mixture with definite limits of tolerance for each ingredient specified; that all essential dimensions and minimum weights be specified, the American Association of Brass Manufacturers being requested to submit suitable specifications for these two items, for approval by the two water works associations. Other items were the elimination from corporation cocks of the ⅜-inch size, round bodies, quarter-bend couplings and certain other features, with the understanding that the use of ½-inch and ⅝-inch sizes is to be discouraged. Also that lead flange cocks for 3A lead be the same as those for 2A lead; that all corporation cocks have two flat sides for wrench hold and those 2 inches or less have a hex on the inlet side; that all lead flange corporation cocks have the coupling thread used by the H. Mueller Manufacturing Co. for 2A lead pipe; that the thread on the inlet end of corporation cocks be either the Mueller thread, the coarse thread for wood mains, or the standard iron pipe thread, the last, however, to be discouraged; that all couplings (including meter couplings) and all solder nipples have full bore, and certain other items with respect to corporation cocks, curb cocks and couplings.

This report was signed by David A. Heffernan, water works superintendent of Milton, Mass., representing the New England Water Works Association; W. R. Edwards, of Paterson, N. J., and J. Walter Ackerman, of Watertown, N. Y., representing the American Water Works Association; and Fred Mueller, of the H. Mueller Manufacturing Co., and Fred Schulder, of the United Brass Manufacturing Co., representing the National Association of Brass Manufacturers. This report, we suppose, together with the specifications of the brass manufacturers for items one and two above referred to, will be submitted to the three societies represented on the committee for their formal adoption.

PUBLIC WORKS

Published Weekly
by
Public Works Journal Corporation

Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba..$3.00 year
All other countries ....$4.00 year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

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Municipal Relief of Unemployment

"Cities and towns must be relied upon for immediate attack upon the emergency created by unemployment." This is the opening sentence of the report of the "Committee on Municipal Organization for Unemployment" appointed by the "President's Conference on Unemployment," made public on October 5. On the same date it was announced that Col. Arthur Woods, who was in charge of finding positions for ex-service men, has been designated by Secretary Hoover to head a special committee for co-ordinating the nation-wide work of relieving unemployment. The report makes some practical suggestions for the procedure of local committees which will probably be published broadcast throughout the country in the daily papers, and should be read and considered carefully by all municipal officials.

We believe that all cities should and will do their parts in relieving the situation by carrying out public work and urging private work. But we believe also that they should bear in mind the President's advice that what is necessary in the present emergency is the stimulating of normal business conditions, and that the mere spending of public funds without obtaining needed returns and value received therefor should not be considered. If those furnishing either material or labor endeavor to take advantage of the efforts being made to increase the amount of public work by demanding abnormal wages or prices, then work requiring such materials and labor should be eliminated from the program until the demands become reasonable.

Some officials already have taken such action. This spring the governor of Illinois refused to endorse the awarding of new contracts for state construction of concrete roads because he believed that the price asked for cement was too high, and in many other localities similar action has been taken. Bradstreet's reports wholesale commodity prices on September 1 as averaging 20 per cent above those of 1913, and the Department of Labor 52 per cent; therefore a charge for any commodity that is more than 30 to 50 per cent above the 1913 prices may be considered as exceeding the present reasonable rate, and there is presumably profiteering somewhere in its manufacture or marketing.

The same is true of labor. The average wages for common labor in New York state are 84 per cent higher than in 1914, and those of skilled labor are 100 per cent or more. Until wages are reduced to not more than 50 per cent above the pre-war basis, the laborers have no reason for complaint if work is not abundant. In some cities of the New York district wages of carpenters and other skilled labor have actually been increased during the past month as the result of an all-summer strike. We believe that the demands of labor for the maintenance of wages at a level higher than the present normal for basic commodities is largely responsible for the present unemployment, sharing this responsibility with the dealers in building materials who are holding the prices of such materials at an average of 100 per cent above pre-war prices.

We do not wish to dissuade any city from doing all the public work that it is possible to do to advantage—we urge them all to do so, in fact. But labor and dealers in materials should do their part and be reasonable in their demands; and if any are not, preference should be given, in deciding upon what work to do, to those willing to sell their services and products at a rate no higher than the present normal.

A notable illustration of what can be done is offered by Pittsburgh. The Bureau of Engineering of that city reports to us that it "has been endeavoring to get all public work possible under contract in order to relieve the unemployment situation, and to date approximately $7,000,000 of public improvements (representing physical cost) has been placed under contract. . . . The construction program, so far as possible, is being formulated to permit as much work as possible to be carried on during the coming winter, giving preference to such classes of work as can be started during the near future. . . . During the winter, excavation contracts will be continued and likewise sewer contracts, and the work on some of the bridges . . . will be proceeded with. . . . Labor is at 25 and 30 cents. Union carpenters have just accepted a new rate of $1.00 per hour. The present condition of the labor and material markets is considered very favorable to the prosecution of public works contracts."

There is hardly a community that has not deferred some needed public work until conditions should become more favorable. If even a part of this deferred work be begun at once, there will be labor for all who will accept it, both directly on these works and indirectly in manufacturing materials and appliances for use on them.

Water Purification at Toledo

Insufficient basin and filter capacity prevent successful use of iron and lime coagulation. Sand incrusted and tastes and odors excessive. New filters now in use.

In the annual report of the Division of Water of Toledo for the year 1920, Water Commissioner George N. Schoonmaker transmits the report of R. W. Furman, chemist in charge of the water purification works, which contains a number of interesting items. During the year 22 new filters were added to the existing plant, these relieving a situation which was becoming serious. During the first ten months of the year the existing filters were taxed to their capacity, the daily pumpage repeatedly exceeding their normal capacity of 34 million gallons. Filter washing was necessary each day and, although algae and similar organisms were not present in such abundance as during 1919, much difficulty was met in supplying enough water.

During January and part of February aluminum sulphate was used as a coagulant. Throughout this period the hardness of the water was the highest on record and complaints were numerous concerning both the hardness and an intense taste and odor that persisted from November, 1919, until April, 1920. Although the taste in the filtered water was decidedly less than in the river water, the hardness on the other hand was greater, reaching 425 parts per million in February, when an iron and lime treatment was substituted for alum.

FILTER INCRUSTATION FROM IRON-LIME TREATMENT

The change in treatment, however, only accentuated the trouble from tastes and odors, but was continued for two weeks, when the spring breakup and heavy precipitation combined with melting ice and snow give some relief in both hardness and taste. Through the latter part of February and the greater part of March alum was used again and the tastes and odors gradually disappeared entirely. For the remainder of the year a moderated iron and lime application was used. On account of the prohibitive price of alum, it was impossible to change back to this material in October, as has been customary heretofore.

It has been found in this plant that by the continued use of iron and lime for about nine months the sand becomes incrusted to the extent of approximately 5 per cent, but these deposits have in previous years been removed without difficulty by using alum for the succeeding three months. This difficulty with using iron treatment is increased in winter because of the low temperature and the fact that insufficient basin capacity does not allow time enough for the proper reactions necessary with the iron-lime treatment.

The effect of an iron-lime treatment when the temperature has fallen below 5 degrees Centigrade was apparent during the latter part of November, when the incrustation of the sand increased rapidly. The treatment was so regulated that the normal carbonate alkalinity of the filtered water would not exceed 6 to 8 parts per million, but complete reaction did not occur until filtration, when the normal carbonate alkalinity was reduced as much as 35 parts per million and the resulting incrustation on the sand reached 30 per cent in a little over two months. It was found that in another plant using water from the Maumee river (the river from which Toledo draws its supply) the incrustation was but 4.5 per cent in December, although the same iron and lime treatment was used; but in this plant the period of sedimentation averaged 15 hours. This experience seems to indicate decisively that more basin capacity is needed at the Toledo plant if iron and lime are to be used during the cold months of the year, and Commissioner Schoonmaker, in his report, recommended that arrangement be made for the construction of a 10,000,000 gallon sedimentation basin (which had already been planned) when the condition of the bond market is favorable.

For treating 10,300 million gallons of water during the year there were used 533 tons of alum, 1,818 tons of iron, 1,583 tons of lime, 8.3 tons of chlorine and 10.3 tons of hypochlorite.

TASTES IN THE WATER

During the year two complete investigations were made jointly by engineers of the State Department of Health and by the Toledo laboratory because of complaints of tastes and odors in the filtered water. Chemical and bacterial analyses were made of the river water at intervals of a few miles between Toledo and Defiance. Because of the fishy taste, consumers insisted that there must be tons of dead fish in the river which were polluting it, but inquiries failed to disclose any evidence of a collection of fish at any point in the river. Investigation did establish, however, that the tastes were not of a harmful nature but were prevalent in dozens of cities in that section at that time and were probably due to algae. Numerous tests showed that the dissolved oxygen content of the river water at this time reached as low as 34.5 per cent saturation.

WATER WORKS FINANCES, LABOR AND METER RATES†

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft.; g-per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Montana:											
Havre	M	$4.00	8	$2.50	8	.23f; .30g	.23f; .30g	$85.00	$15.00	Drawing on surplus	No
Libby	P	3.60	8	3.00	8	no meters	....	....	....	Cutting force	Yes
Nebraska:											
North Platte	M	.50	9	.25	10	......	.15-.05g	....	....	Increased rates	No
Nevada:											
Carson City	P	5.00	8	3.00	8	.29-.05g	.25-.05g	....	....	....	No
New Hampshire:											
Goffstown	M	4.00	9	3.00	10	.15f	same	....	....	From city treasury	No
Pembroke	M	3.00	9	1.75-2.00	9	no meters	....	....	....	Curtailing in every possible way	Somewhat
Walpole	P	.40	..	.22	..	.30f	.30f	....	....	Surplus	No
New Jersey:											
Belmar	M	4.00	8	2.00	9	.17½f; .23 1-3 g	.17½f; .23 1-3g	.12½	.08	....	No
Burlington	M	3.00	8	1.50	10	.25g	.10g	50.00	30.00	Using surplus	Yes
Chatham	M	4.00	8	2.75	9	......	25% less	153.86	101.03	City treasury, surplus	No
Irvington	P	4.32	9	1.80	9	......	.22f; .30g	....	....	Revision of rates	No
Milltown	M	.50	8	.20	10	.25g	.25g	16.00	33.00	Taxes	No
New Mexico:											
Roswell	M	3.50	8	2.50	8	1.00-.07g	same	80.00	70.00	Cutting force; surplus	Yes
New York:											
Buffalo	M	3.90-3.00	8	2.00	8	.10-.04	.06-.02g	19.05	12.36	Water revenue, bond issues	No
Catskill	M	3.50	8	2.25	8	.10f	.10g	....	....	Increased rates	No
Fort Plain	M	4.00	10	1.50	10	.17f	.17f	....	....	....	No
Frankfort	M	.40	9	.17½	9	no meters	....	....	...	....	No
New York	M	5.00	8	2.50	8	.10f	.10f	....	....	City treas., reducing consumption	Somewhat
Potsdam	M	.40	8	.25	8-10	flat rate	....	....	....	Earnings	No
Sag Harbor	P	.40	..	.20	..	.40-.20g	.40-.20g	50.87	25.44	From revenues	No
Troy	M	4.00	8	2.00	8	0.05g	0.05g	17.37	16.70	By economy	No
Westfield	..	.40	10	.20	10	.10g	.10g	....	....	Water funds	No
North Carolina:											
Monroe	M	2.00	10	1.25	10	.50g	.50g	....	....	Raising rates & reduc. consumption	No
Salisbury	M	2.00	10	1.50	10	.30-.07g	....	72.00	....	Raised rates	No
Washington	M	2.00	10	1.25	10	.30-.08f	same	25.00	20.00	Drawing on surp. & raising rates	....
North Dakota:											
Mandan	M	.40	8	.50-.60	10	.26½f; .40g	same	45.83	same	Cutting force, no extensions	No
Ohio:											
Fostoria	M	.45	8	.35	8	......	1.52-.52½ per mo.	82.00	61.50	Increase in rates	No
Huron	M	4.00	8	2.70	9	.15f	flat rate	....	....	Funds from treasury	No
Milan	M	5.00	10	3.00	10	.10g	.10g	60.00	60.00	....	No
Mt. Gilead	..	3.00	10	2.50	..	.25g	....	....	....	....	....
Oberlin	M	4.00	8	....	..	.28-.187f	.22-.15f	202.71	89.91	Drawing on surplus	Yes
Orrville	M	.50	9	.40	9	.25f	.20f	35.00	35.00	Increasing rates	No
Piqua	M	.40	8-10	.25	8-10	no meters	....	....	....	Increased revenues	....
Oklahoma:											
Hartshorne	M	4.00	10	2.00	10	1.00f	.75f	....	....	Increase in rates	No
Oregon:											
Ashland	M	4.00	8	2.25	8	.16 2-3f	....	....	....	From water receipts	No
Grant's Pass	P	.50	8	.40	10	.40-.06½f	same	102.00	118.80	....	....

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*When rates are on sliding scale, the highest and lowest are tabulated when reported. †Concluded from page 262.

Water Works Finances, Labor and Meter Rates

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft.; g- per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Pennsylvania:											
Clearfield	P	[illegible]	9	1.75	10	.20-.01g	same	....	....	Increased consumption	No
Elizabethtown	P	[illegible]	10	1.00-5.00	10	.09-.25g	same	75.75	same	Drawing on surplus	No
Gettysburg		$4.00	10	$1.75	10	.11-.25g	.12-.25g	....	....	Increasing rates	No
Lansford	P	.52½	9	.22½	9	10-.35g	....	....	....	Increased rates	No
Norristown	P	4.00	10	1.75	10	.20-.05f	same	$85.00	$73.00	Cutting force, drawing on surplus	No
Slatington	M	.35	10	.25	10	.08g	....	....	....	....	No
West Newton	P	.50	9	.25	9	.50g	....	....	....	Increased rates	No
Rhode Island:											
Providence	M	.52	9	.19½	9	.15f; .20g	same	55.00	14.60	From water receipts	No
Woonsocket	M	.40	8	...	.	.21f	....	....	...	....	
South Dakota:											
Aberdeen	M	.50	9	.22½	10	.15g	.15g	....	....	....	No
Tennessee:											
Columbia	..	2.00	10	1.00	10	.35g	....	....	....	Increased rates	A little
Fayetteville	M	2.50	10	1.50	10	.60 .11f	.40-.08f	gravity	gravity	....	No
Greeneville	M	3.00	10	1.50	10	.25g	....	....	....	....	No
Johnson City	M	3.00	10	1.25	10	.37-.5+g	....	....	...	Increased rates and business	No
Texas:											
Longview	M	2.50	8	1.25	10	.45g	.20g	240.00	150.00	Increasing rates	....
Sulphur Springs	M	2.00	8	1.50	10	.20g	.15g	....	....	Cutting force	Yes
Waco	M	2.50	8	1.75	8	......	....	.09		Less improvements	Yes
Utah:											
Murray City	M	3.00-3.75	8	2.75	8	.10g	.10g	..		From treasury	....
Vermont:											
Barre	M	3.50	8	....	..	.20-.03f	.16-.08f	....	....	Reducing extensions	Yes
Barton	M	3.00	9	1.50	10	no meters	....	....	...	....	No
Montpelier	M	3.50	9	2.00	9	.10f	same	....	....	Surplus	No
Virginia:											
Lexington	M	3.00	10	1.50	10	.25g	.25g	gravity	gravity	Increased consumption	No
Washington:											
Auburn	M	4.00	8	2.50	8	.15f	.25f	122.80	....	Increased consumption	No
Cle Elum	M	6.00	8	2.50	8	.06-.10g	same	....	....	Raising flat rate	No
Ellensburg	M	1.50	[illegible]	2.50	8	.13g	flat	32.20	....	Drawing on surplus	Yes
Wisconsin:											
Janesville	M	.40	9	.25-.30	9	......	10 per M	60.04	18.60	Bond issues	No
Lake Geneva	..	5.00	9	4.00	9	.35	same	....	....	....	No
Monroe	M	3.50	10	1.50	10	.25-.07f	same	....	....	....	No
Wyoming:											
Sheridan	M	4.00	8	2.00	10	.11-.04f	....	....	....	City treasury	....
Ontario:											
Toronto	M	.60	8	.28	9	.13¾g	.10-.07½g	1.05	.83	Increased rate	No

*When rates are on sliding scale, the highest and lowest are tabulated when reported. a—1916. b—1915. c—1917.

How to Be a Successful Engineer

Advice by one of the deans of the profession, naming what he considers to be the five most important elements that contribute to an engineer's success.

At the installation of a student chapter of the American Society of Civil Engineers at Purdue University, Prof. Ira O. Baker delivered an address to the students which contains in brief and forceful language much advice that should be helpful not only to students but also to all the young men in the engineering profession. Our space will not permit us to give the address in full, but we have endeavored to give the gist of it in the excerpts quoted below. We believe that every engineer would benefit by reading these, and still more by reading the complete address.

"What are the most important elements that contribute to the success of an engineer? They can be included under five heads, namely: (1) technical ability; (2) breadth of knowledge; (3) initiative; (4) executive ability; and (5) ability to write and speak clearly and forcefully.

"1. **Technical Ability.**—Apparently, in the past at least, the chief aim of the engineer has been to perfect himself in technical details. Many, if not most, engineering instructors have been impressed with the magnitude of the field of engineering knowledge, and have given their best efforts to imparting to their students what they believed to be the technical information needed in their future work. Therefore, the chief aim of the engineering student has been naturally, and almost universally, to acquire facts about his chosen profession. . . . In various ways the profession is now seeking to overcome this handicap.

"What may the engineering student do to correct this mistake? First, he must be thoroughly convinced that the mere accumulation of technical information has little or no educational value. He should never overlook the fact that the power to observe closely, to reason correctly, and to state clearly are of vastly greater importance than any amount of technical information; and he should not forget that technical details without these qualities are absolutely useless. Technical details speedily get out of date; but these qualities are never out of date, and are always valuable whatever a man does. . . .

"The power to acquire information, and the knowledge of how to use it, is of far greater value than any number of the most useful facts. I repeat that the accumulation of facts is practically worthless.

"2. **Breadth of Knowledge.**—The second factor I mentioned as necessary for the success of an engineer is breadth of knowledge. The engineer should understand at least some of the fundamentals of economic problems, of social conditions, or political questions, of legislative action, and know something of the subtle relations of labor and capital, of the factors affecting international trade, and of other questions that form the subject of the thinking and conversation of his business associates and other professional men. If the engineer is found seriously lacking in knowledge of these subjects, the layman considers him an ignorant man. . . .

"One of the best means of broadening his horizon is to read regularly and systematically a good technical journal; but an engineering student, in addition to keeping an eye on the less transient and less ephemeral articles of a good daily paper, should also read the political or governmental or financial articles in at least one of the standard monthly magazines.

"3. **Initiative.**—The third important factor in the preparation of an engineer is initiative. The most successful engineer must have the ability to devise new solutions of an old problem, the power to discover new methods of accomplishing results, the capacity to find ways and means without waiting to be told. Without the power of initiative the power of self-direction, no one can hope to be trusted with large responsibility. Men who are at the head of large enterprises and who carry large responsibilities are always looking for those who have initiative; and not infrequently they choose the uneducated man, or perhaps I should say the unschooled man, who has the power of initiative, in preference to the college trained man who does not have it. . . .

"The cultivation of the power of initiative, of self-reliance, of self-direction is the most important phase of a college education. If a student has a problem which baffles him, he should not be content to lay it aside with the expectation that the instructors will explain it at the next recitation; but he should regard such a problem as a challenge to his intellectual power, to his ability to overcome obstacles, and he should earnestly, even enthusiastically, wrestle with the difficulty until he has overcome it. . . .

"5. **Ability to Write and Speak.**—Fifth, and last, I come to the consideration of one of the most serious mistakes, if not the most serious of all the mistakes, engineers have made in the past. The engineer, in college and also after graduation, has been so intent upon perfecting himself in technical details that he has neglected the means of communicating his thoughts by writing or speaking to his fellow men. The engineer, if he is to attain to any considerable prominence or influence in his community, must do business with other men, must explain plans, must write letters, must prepare contracts, must give testimony in court, must write reports; unless he has acquired the ability to express his thoughts in clear and forceful English, he cannot influence others to accept his views, or convince others that he is an intelligent or educated man. Other men are not able to judge him by his technical attainments, but do judge him by his ability in writing and speaking. Unless he uses clear and forceful language, others are likely to assume that he is an ignorant man, and consequently his professional standing suffers and his influence as a citizen is weakened. . . .

"I firmly believe that some engineers by their crude, confused and incorrect speech discredit all engineers and do much to prevent the recogntion of engineering as a profession. Such men are in a large degree responsible for the low pay and lack of honorable recognition of engineers.

"Of the five qualifications I have discussed, the ability to write and speak clearly and forcefully is the one most easily obtained and the one that is most important in its effect on the success of the engineer. That is a pretty strong statement, but in my opinion it is strictly true."

Summer Use for Snow Plows

Like most other northern cities, Buffalo, N. Y., is provided with snow plows that can be attached to the front end of trucks or tractors to be used in removing snow from the city's streets. The trucks or tractors so used are presumably in service throughout the remainder of the year on work for which they were regularly designed, but the plows themselves have been stored, except during the few days of the year when snow removal is necessary. The street department of Buffalo uses Champion snow plows, some of them at least being attached to Bates "steel mule" tractors.

Early in the spring of this year W. F. Schwartz, street commissioner of Buffalo, decided to try the use of the city's snow plows in distributing ashes and rubbish on the lake shore dumps, where the city is reclaiming land—work which heretofore had been performed by scrapers hauled by city teams and by men spreading the refuse by hand shovel. A tractor with snow plow attached was started on this work in March and has been used continuously since that time, working almost continuously with very few delays or interruptions. Commissioner Schwartz recently stated that this plan, which is in direct charge of Mr. Kilgallon, of the department of streets, "has worked out very satisfactorily and we are more than pleased with the work done."

The loads of rubbish are dumped on the top of the fill near the edge and are pushed forward by the machine. The plow being hung in front of the machine, the material can be shoved to and beyond the edge, which is impossible with a horse-drawn scraper. Moreover, it can be spread more quickly and to better advantage, as well as more cheaply.

During the last of August and the first of September a ten-day test was run by Mr. Kilgallon. During this time the number of loads spread per day varied from 45 to 60, each load containing about 5½ cubic yards. The amount of gasoline used was 4 gallons per 8-hour day, but 7 is required in winter work. The amount of oil used was 2½ quarts per day and 2 gallons per week of heavy transmission oil. During the six months the cost of repairing and overhauling the tractor has been $50, while practically none has been required for the snow plow. It required two men to handle the machine, one running the tractor and one to handle the plow.

The plow performs work previously done by a team drawing a scraper and four men. As the equipment would otherwise be lying idle, any operating profit obtained by this use reduces by that much the overhead of snow removal work.

Pennsylvania's Improved Highways

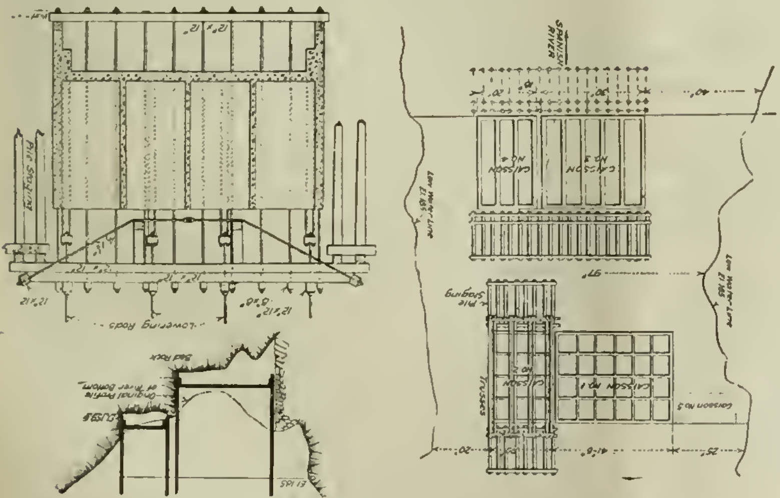
Prior to 1919 there were in the state of Pennsylvania 3,800 miles of improved highways, an amount which at the end of the present year will have been increased by 1,150 miles improved since 1919 and 200 miles that will have been completed by the end of this season, making a total of 5,250 miles; to which it is stated by Lewis J. Sadler, Pennsylvania State Highway Commissioner, that 1,000 miles more should be added in order to provide a system of roads serviceable for the entire state. Under present conditions it is now possible to drive 1,000 miles over continuous hard-surface roads in the state of Pennsylvania. An up-to-date comprehensive system of construction has been developed and should be continued, eventually becoming chiefly one of maintenance.

SNOW PLOW USED TO SPREAD REFUSE ON PUBLIC DUMP BY CITY OF BUFFALO

Crib and Cofferdam Work III*

Pneumatic caisson cofferdams for dams and for excavations in quicksand. Correction of leaks in cofferdams. Unwatering cofferdams by pumping and draining. Permanent construction cribs.

In some cases where great strength, accuracy or permanence is required or where the bottom is such that it is extremely difficult or impossible to seal ordinary cofferdams on it and make a watertight joint with the surface of the ground and sheeting cannot be driven or core-walls placed, cofferdams have been made with pneumatic caissons, which it is not only possible to sink under all possible adverse conditions, but which can be bonded together by forming efficient construction joints between them and making a continuous solid wall of any required length and dimension. A pneumatic caisson cofferdam has the additional advantage of being fitted to horizontal bearing on the earth or rock below the surface and thus securing great resistance against transverse displacement. Generally when pneumatic caissons are used for cofferdams the design is such that they subsequently form part of the necessary permanent structure.



CONCRETE PNEUMATIC CAISSONS FORMING UNITS OF COFFERDAM

Pneumatic caissons have been used in the construction of cofferdams for the unwatering of river channels to prepare the site for permanent dams. An example is in the St. Maurice river, Canada, where the water was very deep and swift and the river bed was of jagged rock deeply covered with large loose boulders. Some of these were removed so as to permit a portion of the dam to be built inside crib cofferdams and the remainder, where the cribs could not be located, was built with pneumatic caissons arranged to form the foundations for the upper and lower toes of the permanent concrete dam, but having a space between them that was unwatered and excavated by hand to provide for the placing of the mass concrete that formed the remainder of the foundations of the dam inside the limit of the crib cofferdam. In this case reinforced concrete was used for the construction of the caissons, which were built on platforms suspended from temporary towers and gradually lowered to the bottom of the river by slacking off the nuts on vertical rods by which the caisson was suspended from falsework trusses.

FOR FOUNDATIONS OF BUILDINGS

Important examples of the use of pneumatic caissons for cofferdams are seen in the construction of the substructures for very tall and heavy office buildings in New York, where they are located on fill and quicksand up to 100 feet or more in depth overlying hardpan and solid rock. The foundations are carried through the strata to rest on rock by the pneumatic caisson process, which is applied to the construction of the concrete piers supporting the columns in the outer walls of the building. These caissons are steel, wood or generally at present of reinforced concrete, are made comparatively long, narrow and high, and are sunk close together end to end, to make a sectional wall continuous around all sides of the lot or enclosing sides not previously enclosed by similar constructions or existing buildings.

These caissons, sometimes extended by detachable cofferdams on top, are sunk into the rock and the spaces between them are cleared of the quicksand and earth and are filled with concrete extending into cavities at the ends of the caissons, thus bonding the adjacent caissons together with watertight joints and forming in reality subterranean cofferdam with the top, or at least with a detachable cofferdam on top, reaching above ground water level and frequently still higher to the temporary surfaces of the general excavation, which is later depressed. As the cofferdam prevents the flow of water and quicksand into the space enclosed by it, this, being a relatively small area, can be easily unwatered and the remaining operation of heavy excavation, concreting, waterproofing and erection, is advantageously carried on and the interior piers are thus built much more cheaply in the open than they could be by the pneumatic process. Eventually the excavation is completed inside the cofferdam and as it is carried down tremendous unbalanced pressure of the semi-fluid mass on the exterior causes a great horizontal thrust that must be resisted by a system of very heavy temporary cross struts of large timbers from 10 to 20 feet apart horizontally and 5 or 6 feet apart vertically, which are finally replaced by the beams and girders in the permanent floor system.

LEAKS

When leaks occur through earth cofferdams it is generally because the material is inferior or inadequate and more material has to be dumped on the outer space of the cofferdam to close the leaks. For this purpose clay is the best, but if the leak is very large or if an opening has actually been made in the cofferdam there may first be placed a quantity of broken stone or any convenient material covered with earth and later with clay. Sometimes, too, it may be advantageous to sink a large piece of canvas in a horizontal position over the suspected leak and cover it with a heavy bed of earth and clay.

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*Continued from page 257

If the leak occurs at the outer toe of the cofferdam it may be often remedied by enclosing it with a line of sheet piles. Although these piles are not at first absolutely watertight they will shut off any considerable flow of water and may eventually become tight.

Leaks through wooden sheet piling may be stopped either by an embankment against the outer face or by driving additional piles parallel to the existing piles and filling the space between them with puddled clay.

Leaks through steel sheet piles often occur in the clearances of the installation joints and are likely to gradually silt up, but if the water is very clear or for any other reason setting up does not take place, they may be sometimes closed by driving long wooden splines in the joint if the clearance is sufficient or sometimes by injecting grout into the joints. When the piles are broken or when they are obstructed so as not to be driven to the required depth another row may be driven parallel to them.

Sometimes relief of leakage may be had by divers examining the leaks and depositing bags of sand and concrete to fill the cavities. The bags should be only partly filled in order to enable them to mould themselves to the required contours and if the concrete is deposited in paper bags the paper may or may not disappear later. If deposited in burlap bags it generally will penetrate through the fibers of the fabric and form cemented joints with adjacent bags.

Large leaks in the vertical faces of cofferdams may sometimes be examined and stopped by means of small auxiliary movable cofferdams, called suckers, with three sides and a bottom but open on the fourth side and top and with the vertical edges provided with gaskets, which may be lowered alongside the face and held by the water pressure against the face of the cofferdam. Such cofferdams are frequently used in shipyards.

INTERIOR BOTTOM LEAKS

The most serious leakage into cofferdams is upward through the bottom where the ground is porous or where the bottom is of rock with seams and fissures. It is always difficult and sometimes impossible to control. In rock bottom it may be possible to drill rows of holes in the cofferdam and even outside of the cofferdam, piercing the water-bearing strata or rock seams, and through these holes force grout in successive applications until it has closed the seams and shut off the flow of water. This method was successfully adopted in the construction of the Olive Bridge dam and of a cofferdam in the Ohio river.

Generally where separate leaks are disclosed inside the cofferdam, sumps or wells are excavated around them and the suction of a powerful pump is introduced to draw the water away if possible. In other cases, if the leak is sufficiently concentrated, it may be enclosed with a watertight well or shaft or a vent pipe sealed into it and the water allowed to rise freely and overflow over the top of the cofferdam.

Experiments have been made to close leaks in the bottom of an area of a cofferdam by means of the freezing process applied by the circulation of cold air through pipes in trenches or on the bottom. This method is, of course, extremely slow and very costly and probably will never be resorted to unless under extreme conditions. The circulation of brine requires a somewhat smaller installation but is likely to defeat its own object, since if leaks occur in the pipes the escaping brine prevents local freezing. The circulation of compressed air is little injured by leakage, for this causes expansion and increased refrigeration.

When the leaks are very numerous or very strong, it is often advisable to subdivide the cofferdam by interior partitions of the same character as the outside cofferdam or of different nature, as may prove desirable, and then concentrate all of the unwatering efforts on one division at a time, thus completing the excavation and generally affording an opportunity to concrete the bottom and seal the leaks so as to successively progress over the entire area. It is sometimes advisable to anticipate this method, especially if the cofferdam is composed of piling that can be driven so that only enough of it may be installed to form one or two subdivisions of the cofferdam and from which it can be pulled and redriven to make the successive sections.

UNWATERING COFFERDAMS

Unwatering the cofferdam is almost always performed with pumps, but if the topography is favorable it may sometimes be done by a syphon or by direct drainage through pipes or canals to disposal at the lower level. If syphoning is possible, the pipes can be carried over the top of the embankment and to as great a depth and for as long a distance as is necessary, provided the outlet is sufficiently below the bottom of the cofferdam to provide a head to overcome friction.

The syphon can be put in operation by pumping or by closing both ends and filling it with water while the air escapes at the summit. If pipes are inserted through the cofferdam, great care must be taken to protect the latter from leakage around them, especially in earth embankments where any leakage would be sure to cause serious scouring and where the pipes inserted should be built in as the cofferdam is constructed and provided with cross walls, stops, and proper facing to protect the intake.

Pumping for very small cofferdams may be accomplished with hand diaphragm pumps if the lift is low and the cofferdams and bottom are tight. Usually, however, power pumps will be necessary, and for small work or where the leakage is light, these may be of moderate size and driven by gasoline engines. For large cofferdams or heavy leakage or long-continued work it will be necessary to install plunger or centrifugal pumps operated by steam or electric power.

Usually centrifugal pumps are the simplest and most efficient and give very good service for ordinary lifts and large volumes of water. Sizes of 2 to 6 inches, according to the magnitude of the work are generally used, although 8 and 10-inch pumps are occasionally installed. The pumps may be used singly for different sumps or they may be combined in batteries in two or more sumps. Under favorable conditions the cofferdam can be unwatered by constant heavy pumping and then kept dry by operating one or two pumps a portion of the time or one pump constantly working at low capacity.

PERMANENT CRIBS

Cribs are used not only for auxiliary purposes as cofferdams, but for primary construction for foundations of walls, retaining walls, bridge piers, abutments, and other foundations, generally for submerged operations. When used for such purposes they differ little, if any, from the cribs used for cofferdam construction except that they are likely to be filled completely with broken stone or with concrete.

They are built with the bottoms fitted to conform with the profile of irregular rock or with horizontal bottom to be sunk to a level surface or in a dredged excavation. They are sunk by rock or earth ballast and when completely filled serve as a footing for stone masonry or concrete, which always extends below water level and is generally built either in very shallow water just below low water elevation or in detachable cofferdams that are easily maintained on the tops of the cribs and removed after the structure is finished.

Crib foundations are most used in very swift, deep current and on very irregular rocky bottom and for sea walls, quays and foundations that are exposed to heavy wave action. They can be built in safe locations on shore, floated to position under favorable conditions, and can quickly be ballasted and sunk and made temporarily stable to resist displacement before completion of the substructure. When used for bridge piers they are generally filled solid with concrete deposited in their pockets under water by the tremie method or with bottom-dump buckets carefully lowered to position. As they are wholly submerged, no attempt is made to make tight sides and wide interstices are frequently left between the timbers.

Sometimes the crib walls are made of planks laid flat with spaces between them and serve merely as a container for the concrete and to break the force of the current. Recently cribs have been made of reinforced concrete of large dimensions built on shore, fitted with false bottoms, lifted by heavy derricks, launched and floated to position or carried on barges, sunk to the bottom and later filled with concrete. An example of very large concrete cribs is seen in the harbor improvement construction at Halifax, N. S.

Mosquito Control by Use of Top Minnow

Ichthyologist Samuel F. Hildebrand recently made the following report on the prompt control of mosquito production by employment of Gambusia in large numbers, this report being published by the United States Public Health Service in "Public Health Reports."

"Unusually heavy rains were experienced around Augusta, Ga., early in July. As a result, many temporary ponds were formed. A pond, covering about one-fourth acre of ground, was observed on July 18 to contain mosquito larvae in countless numbers. Culicine larvae predominated, but many anopheline larvae were also found. The mosquito larvae were uniformly distributed over the pond. Previous to the July rains this depression was completely dry, but it gave evidence of having been under water for a considerable period of time since aquatic plants, cattails, and arrowheads were well established. Smart weed, Bermuda grass and foxtail occurred along the edges of the water. On July 19, approximately 2,000 Gambusia were introduced. On the evening of July 20 no wiggletails were visible in open water, but they were exceedingly numerous in the vegetation where they had gone for protection. On and after July 26 only an occasional small wiggletail could be found."

As the fish were obtained from an abundantly stocked pond only about 300 yards distant, they were transferred about 500 at a time in a wooden tub, the work requiring less than half a day's time of one laborer. The cost in this instance for complete, prompt and continuous control of mosquito production was not more than $1.

Varieties of Paving Brick

At the request of the United States Department of Commerce the National Paving Brick Manufacturers' Association has, during the past few weeks, been collecting from the various manufacturers of paving brick information concerning the various kinds and sizes of brick which each manufacturer has shipped during the past ten years. It would appear from the blank sent out for the manufacturers to fill in that at least 15 different sizes and types have been in more or less common use, since these are especially mentioned in the questionnaire, while some manufacturers have been asked by purchasers to provide still different ones, we understand.

The several types and sizes specified are as follows: Plain wire-cut brick and block, 8½ inches long, 4 inches deep and either 2½, 3, 3½ or 4 inches wide. Vertical fibre bricks with lugs, dimensions the same as above. Dunn wire-cure-lug brick, 8½ inches long, 3½ inches deep and either 3, 3½, 4 or 5 inches wide. Repressed brick, 8½ inches long and 3 by 4 or 3½ by 5 inches. It is the belief of the Department of Commerce and of the National Paving Brick Manufacturers' Association that it will be to the advantage of both consumer and manufacturer if these various types and sizes be reduced to not more than 3 or 4 instead of the considerable number now in more or less common use.

Recent Legal Decisions

CONSTRUCTION OF NEW JERSEY STATUTE AS TO SOURCES OF MUNICIPAL WATER SUPPLY

In an action as to the validity of a permit granted by the New Jersey state board of conservation to the borough of Wharton to divert water from the Rockaway river to provide a better water supply, the New Jersey Court of Errors and Appeals holds, Fagen v. Mayor, etc., of Borough of Wharton, 113 Atl. 920, that the limitation of the Act of March 16, 1916, par. 18, that it shall be unlawful for any municipality to obtain a new or additional water supply from any watershed other than the watershed or watersheds from which said municipality obtains its existing water supply without the consent of the district water supply commission, the court said, "must be read in connection with the entire act, which has reference to granting permission to any municipality, and the prohibition was not intended to deprive the state board of its special oversight and powers in all cases. If it be otherwise, then the state board is powerless to oversee the acts of the district board. We also think the evidence shows that there is a public necessity for the new supply."

ORDINANCE AS TO REMOVAL OF ASHES HELD NOT DISCRIMINATORY AS AGAINST APARTMENT HOUSE OWNERS

The Maryland Court of Appeals holds, Mayor, etc., of Baltimore v. Hampton Court Co., 113 Atl. 850, that ordinance No. 55 of the mayor and city council of Baltimore, approved December 20, 1915, adding a new section to the Baltimore City Code, 1905, art. 26, to be known as sec. 2-A, making it the duty of the commissioners of steet cleaning to remove all ashes from dwelling houses, apartment houses and tenement houses, with the limitation that such ashes shall not exceed 15 bushels per week, is not capricious, oppressive, unreasonable, or discriminatory, against owners of apartment houses having a larger amount of ashes than their neighbors who do not live in apartment houses. The court said that "it does not seem to be any more unreasonable to require owners of large apartment houses to provide for the removal of their ashes in excess of the amount produced by the owner of large dwellings, than to require hotels, factories and department stores producing large quantities to remove the same, as we said in Mayor and City Council of Baltimore v. Hampton Court Co. (126 Md. 341, 94 Atl. 1018), they could be compelled to do."

AUTHORITY REQUIRED FOR PURCHASE OF FIRE ENGINE BY MUNICIPALITY UNDER MISSISSIPPI STATUTE

Under the provisions of chapter 8, par. 43, of the Charter of the City of Columbus, Ohio, as well as under section 3474, Ohio Code of 1906 (sec. 2812, Hemingway's Code), no contract can be entered into by any officer on behalf of a municipality unless "specially authorized thereto by law," or by an order of the board of municipal authorities. The Mississippi Supreme Court holds, Kidder v. McClanahan, that any contract by a municipality for the purchase of a fire engine is not such a contract as the mayor is specially authorized by law to execute for the municipality; and, in order to legally execute such a contract on behalf of a municipality, he must be specially authorized to do so by an order of the mayor and city council entered on their minutes; and such order must either set out the proposed contract in full, making it a part of the order adopting it, or the minutes of the board must show the important and controlling provisions of the contract which he is authorized to sign. The mayor and city council have no right to delegate their power to the mayor to agree on the terms of such a contract.

POWER OF MUNICIPALITY TO ACQUIRE WATER WORKS PARTLY SITUATED IN ANOTHER STATE

On a rehearing of the case of Superior Water, Light & Power Co. v. City of Superior, the Wisconsin Supreme Court, 183 N. W. 254, had before it for consideration the question whether the city could acquire title to that portion of the water company's property situated in Minnesota. The court holds that proceedings on the part of a municipality to acquire the property of a water works company under the Wisconsin Public Utility Law are in the nature of condemnation proceedings, even where the company has voluntarily accepted an indeterminate permit. Although a portion of the property might be physically located beyond the borders of the state, nevertheless, it being deemed personal property, it was held to have a legal status in the state; and therefore the state has ample jurisdiction to deal with the entire property as property within the state and to take the title from the water company pursuant to its power of eminent domain. The city was held to have power to acquire and own water works property beyond the state as well as the city boundaries.

POWER OF VILLAGE UNDER STATUTE TO MAKE FRANCHISE AGREEMENT WITH LIGHT AND POWER COMPANY

The Michigan Supreme Court holds, Village of Plainwell v. Eesley Light & Power Co., 183 N. W. 66, that where a village, pursuant to section 2782, Mich. Comp. Laws, 1915, has made a franchise agreement with a light and power company for a period of 10 years, the power of the village to make such a contract, though exhausted by the making of the contract, was restored by an agreement between the village and the company terminating such contract on the day a new contract was to take effect. Such a contract is not ultra vires as for a longer period than the 10 years authorized by the statute because 5 months and 24 days are allowed the company for preparation and the installation of equipment for performance of the contract.

NEWS OF THE SOCIETIES

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventh annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 11-14—AMERICAN ASSOCIATION OF PORT AUTHORITIES. Annual meeting. Seattle, Wash. Secretary, M. P. Fennell, Jr., 57 Common St., Montreal, Canada.

Oct. 12-14—LEAGUE OF KANSAS MUNICIPALITIES. Annual convention. Lawrence, Kans. Secretary, John G. Stutz University of Kansas.

Oct. 17—ILLINOIS STATE FEDERATION OF LABOR. Aurora, Ill., Headquarters, 166 W. Washington St., Chicago.

Oct. 20-21—CITY PAVING CONFERENCE. Engineers Club of Philadelphia, 1317 Spruce St., Philadelphia. H. E. Hopkins.

Oct. 20-21—OHIO STATE CONFERENCE ON CITY PLANNING. Annual conference. Columbus, Ohio. Secretary-treasurer—Charlotte Rumbold, Chamber of Commerce Building, Cleveland.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary. Charles Carroll Brown, St. Petersburg, Fla.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F, Morgan, Devonshire st., Boston

Nov. 14-16—CITY MANAGERS' ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. **New York City.**

Nov. 16-18—NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

Nov. 17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Society of Naval Architects and Marine Engineers. New York.

Nov. 17-18—SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS. New York.

Dec., 22-23—KANSAS ENGINEERING SOCIETY Hutchinson. Kan.

Jan. 17-20—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

AMERICAN PUBLIC HEALTH ASSOCIATION

The fiftieth annual meeting of the American Public Health Association will be the occasion of a Health Fortnight. From November 8-19, New York City, will be the scene of activities connected with this event, and the publicity with its slogan "Health First" will stimulate interest throughout the country.

Health Fortnight will include three major divisions—a Health Institute from November 8-11; a Health Exposition, November 14-19; the Fiftieth Annual Meeting of the American Public Health Association, November 14-19. Representatives from virtually every State in the Union and from many foreign countries will participate in the extensive program.

To focus the attention of the general public upon this celebration, November 13th will be observed as Health Sunday in many churches. Health Day will also be observed in the synagogues and in numerous business and social organizations. Speakers prepared to talk authoritatively on health topics will be furnished on request to any of those organizations. The New York County Chapter of the American Red Cross is co-operating with the general committee in the arrangement for this service.

The Public Health Exposition will undoubtedly make the widest appeal to the lay public. It will be the largest affair of its kind ever held in New York City. It will be conducted under the joint auspices of the Department of Health of the City of New York and the American Public Health Association. Already allotments of space indicate that at least two entire floors of the Grand Central Palace will be occupied by exhibitors. The exhibits will include those of educational and philanthropic organizations and those of commercial houses producing approved articles of health value.

Every legitimate means will be utilized to promote attendance at the Exposition, for this will be the most effective way in which the message of Health Fortnight may be brought to the public. The fact that a similar health exposition held in Chicago a year ago drew an attendance of over one hundred thousand indicates the extent to which this form of popular education may be carried. Naturally, in New York with its larger population, a proportionately greater attendance is expected at the Exposition. The profits from the sale of tickets, after the cost of the Exposition and the Convention are defrayed, will be devoted to establishing nutritional clinics for the benefit of undernourished children. In this connection, Dr. Royal S. Copeland, Health Commissioner of the City of New York, will present a series of educational exhibits in which instruction in the feeding of children will be featured. Dr. Copeland is chairman of the Exposition; A. W. Hedrich of the American Public Health Association is Secretary and Dr. C. E. North, treasurer and general manager.

The Health Institute from November 8-11, will present to visitors to the Convention an unusual opportunity to see the operations of established methods applied to various phases of public health work. About forty demonstrations have been planned. The thoroughness of the program may be gathered from the fact that the Institute is sponsored by the American Public Health Association, the Health Department of the City of New York, the New York State Department of Health, the U. S. Public Health Service, the National Health Council, and the Committee on Public Health of the New York Academy of Medicine, with the co-operation of approximately one hundred other organizations. The chairman of the committee in charge is Dr. W. E. Evans. The Director of the Institute is Dr. D. B. Armstrong of the National Health Council.

PERSONALS

Marsh, Robert S., of Alliance, Ohio, has been made state architect and engineer of Ohio, and will be connected with the department of highways and public works.

Hutson, W. F., is now district engineer of the Texas state highway department at Waco, Texas.

O'Donnell, James E., has accepted a temporary position as city manager of St. Albans, Vt., to fill the vacancy due to the recent resignation of Athole B. Edwards.

Keller, Col. Charles, Corps of Engineers, U. S. Army, has been appointed engineer-commissioner of the District of Columbia, succeeding Col. Charles W. Kutz.

Sheets, Frank T., until recently engineer of design in the division of highways, Illinois Department of Public Works, has been promoted to the position of superintendent of highways, which position was formerly held by S. E. Bradt, resigned.

Bennett, J. B., has been appointed county engineer, Pottawatomie county, Okla.

Ullins, F. W., Jr., city engineer of Shorewood, Wis., has been appointed member of the Metropolitan Sewerage Commission of Milwaukee county. The other members of this commission are Charles B. Perry and George P. Miller.

Smook, Joseph M., has been appointed aid with the U. S. Coast and Geodetic Survey and is now located in Wisconsin.

Foulks, John A., assistant chief examiner of the Civil Service Commission, has been appointed by Director Raymond of the Department of Streets and Public Improvements, Newark, N. J., to head the new division of water in this department, with the title of chief engineer of that division.

Barstow, E. D., head of the department of county sanitary engineering of Summit county, Ohio, who, upon the abolition of the department by the county commissioner, lost his position, has been re-hired as sanitary engineer, effective October 1st.

Smith, R. Home, has been unanimously chosen by the Toronto Harbor Commissioners as their chairman, to succeed the late Hon. Lionel H. Clarke.

Valiquette, J. H., was recently appointed manager of the city of Shawingan Falls, Quebec.

Rochetti, J., chief engineer of the Manitoba Power Commission, has been appointed power commissioner for the province of Manitoba, succeeding J. M. Leamy, who resigned.

Dickerman, Alton L., 71 years old, well-known mining engineer who represented John D. Rockefeller in the development of iron mines in Minnesota, died at Colorado Springs, Colo., on September 15th.

Black, Tanjor, of Whitehall, Mont., has been appointed assistant engineer in the Reclamation Service, and has reported for duty at Malta, Mont., on the Milk River project.

Richardson, Clifford, well known in this country and Europe as a specialist in asphaltic materials and paving methods, is retiring from active practice on October first. He will leave New York City, where he has been engaged as consulting engineer for the Barber Asphalt Paving Co., for Santa Barbara, Cal.

Ward, Robert L. E., has been appointed city engineer of Canon City, Colo.

Smith, Prof. L. S., head of the highway engineering and city planning courses of the university of Wisconsin, has been appointed engineer of the Appleton, Wis., city plan commission.

Conner, R. M., has been transferred to the Riverton project, U. S. Reclamation Service, as construction engineer on diversion dam and canals to irrigate 100,000 acres in Fremont county, with headquarters at Pilot, Wyo.

Shaner, Harry L., has been re-elected by the board of aldermen as commissioner of public works of Winston-Salem, N. C.

Guepel, Louis A., has been appointed sanitary engineer in charge of the Indiana state water and sewage laboratories to succeed John C. Diggs, who has been transferred to the State Conservation Department.

Luedke, A. L., engineer-eonomist of the U. S. Bureau of Public Roads, Washington, D. C., has been transferred to St. Paul, Minn.

Bailey, Paul, has been made chief deputy to W. F. McClure, state engineer of California.

Stephens, U. S., has been appointed county engineer and road superintendent of Runnels county, Texas, to have charge of all road work.

Carter, V. H., formerly chief designing engineer, has been appointed acting harbor engineer in charge of port development, maintenance and reclamation for the Port of Oakland, Cal.

Thomas, E. R., has been appointed city engineer of Port Arthur, Texas.

O'Connor, John, has been appointed superintendent of construction of the municipal water works of Fort Wayne, Ind.

Howe, S. B., has been appointed city engineer of Sioux Falls, S. D., and F. J. Connor has been appointed superintendent of water works.

Eakin, Jacob, formerly assistant city engineer, has been appointed city engineer of Sandusky, Ohio, to succeed Arthur Johnson, who becomes county surveyor.

Shuff, Carl L., of Spokane, Wash., has been appointed state supervisor of reclamation by the director of the Department of Conservation and Development.

Morgan, Arthur E., has been appointed chief engineer for the Pueblo, Colo., Conservancy District Project.

Niles, Arthur H., formerly assistant city engineer of Jackson, Mich., has been appointed city engineer of Sturgis, Mich.

Clark, B. E., acting state engineer and highway commissioner of Oklahoma, has been appointed state highway commissioner.

INDUSTRIAL NOTES

The Consoer Engineering Co., municipal engineers, 140 South Dearborn street, Chicago, have been appointed engineers for the city of West Hammond, Ill., to succeed W. F. Bridge, former municipal engineer.

C. B. Cole has opened an office at 546 West Washington blvd., Chicago, for the practice of consulting engineering, specializing in tools, gauges, interchangeable manufacture and inspection systems, etc.

The National Distributors' Association of Construction Equipment at its semi-annual meeting at Milwaukee, Wis., on Sept. 12th and 13th changed its name to the Associated Equipment Distributors. Morton R. Hunter, 124 Second St., Milwaukee, is the secretary.

The Northwest Engineering Co. of Green Bay, Wis., has purchased the plant, assets and business of the Northwest Engineering Works, and will now manufacture the "Northwest" crane.

The Wood Hydraulic Hoist & Body Co., of Detroit, Mich., has just opened what is considered the largest plant in the world devoted to the manufacture of steel and wooden truck bodies. A separate department has been set aside for the construction of a new Ford power dumping unit, using in its construction a miniature hydraulic hoist.

The American Steel and Wire Co., Chicago, has appointed H. S. Durant sales agent, and M. W. Floto, assistant sales agent, at the Detroit office of the company, to succeed M. Whaling and T. J. Usher, Jr., resigned.

Dwight P. Robinson & Co., engineers and contractors, New York, have been retained by the Brazilian federal government in connection with its plans for the reclamation of its semi-arid states, whih work will include the construction of five large dams, creation of storage reservoirs, etc.

The National Paving Brick Manufacturers' Association has appointed Stanley A. Knisely as economist, and through his department the association will intensify its studies of brick pavement service from an economic standpoint

A. C. Anderson, formerly mechanical engineer with the Putnam Machine Works of Manning, Maxwell & Moore, of Fitchburg, is now engaged in engineering work for the William A. Hardy & Son Co., 133 Water street, Fitchburg.

BLAW-KNOX EXHIBIT

The Blaw-Knox Company occupied Booth 716 in the National Exposition of Chemical Industries, September 12th to 17th, in the Eighth Regiment Armory, New York City.

The exhibit included samples of forge and hammer welded steel plate work, operating models of Blaw clam shell buckets, and sample Blaw-Knox Prudential Sectional Steel Building, also photographs of other products, including Blawforms, structural steel buildings, transmission towers, water cooled furnace appliances and miscellaneous steel plate work.

Construction Problems Handled by Experts

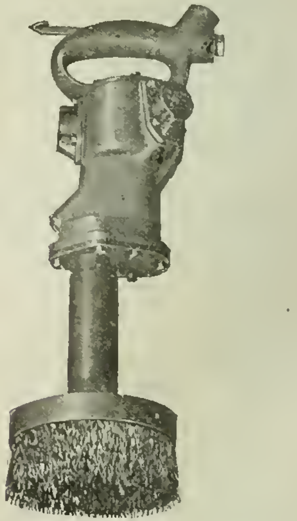
In connection with its plans for the reclamation of its semi-arid states the Brazilian Federal Government has retained Dwight P. Robinson & Co., Inc., engineers and constructors, of New York, to supervise a large amount of engineering and construction work. This work, which is located in the states of Ceara and Parahyba, will include the construction of five large dams—involving nearly a million cubic yards of concrete—to create storage reservoirs, some of which are to be larger than any artificial reservoirs existing elsewhere.

The work is to be conducted under the direction of the Brazilian government, and is under the direct control of the Inspectoria de Obras Contra as Seccas, which is a department of the Ministry of Viacao e Obras Publicas. The inspector-general in charge of the work is Dr. Miguel Arrojado Lisboa. Dr. Pires do Rio is the Minister of Viacoa e Obras Publicas.

Pasadena, Cal., will appoint a city planning commission.

Mayor Tryer, of Los Angeles, Cal., will appoint a harbor commissioner, the president at $4,000 a year and two other members receiving $10 each for attendance at each meeting.

PNEUMATIC CLEANING BRUSH



PNEUMATIC CLEANING BRUSH

For cleaning metal surfaces previous to painting and for other purposes there has been put on the market by the Ingersoll-Rand Company a brush five inches in diameter, made with wires of special heat treated steel that is intended to be used with standard No. 6 Little David Drill. It is very rugged and durable, operated at high speed, can be used in sharp corners and other cramped places, weighs only 11½ pounds and is adapted for many cleaning purposes.

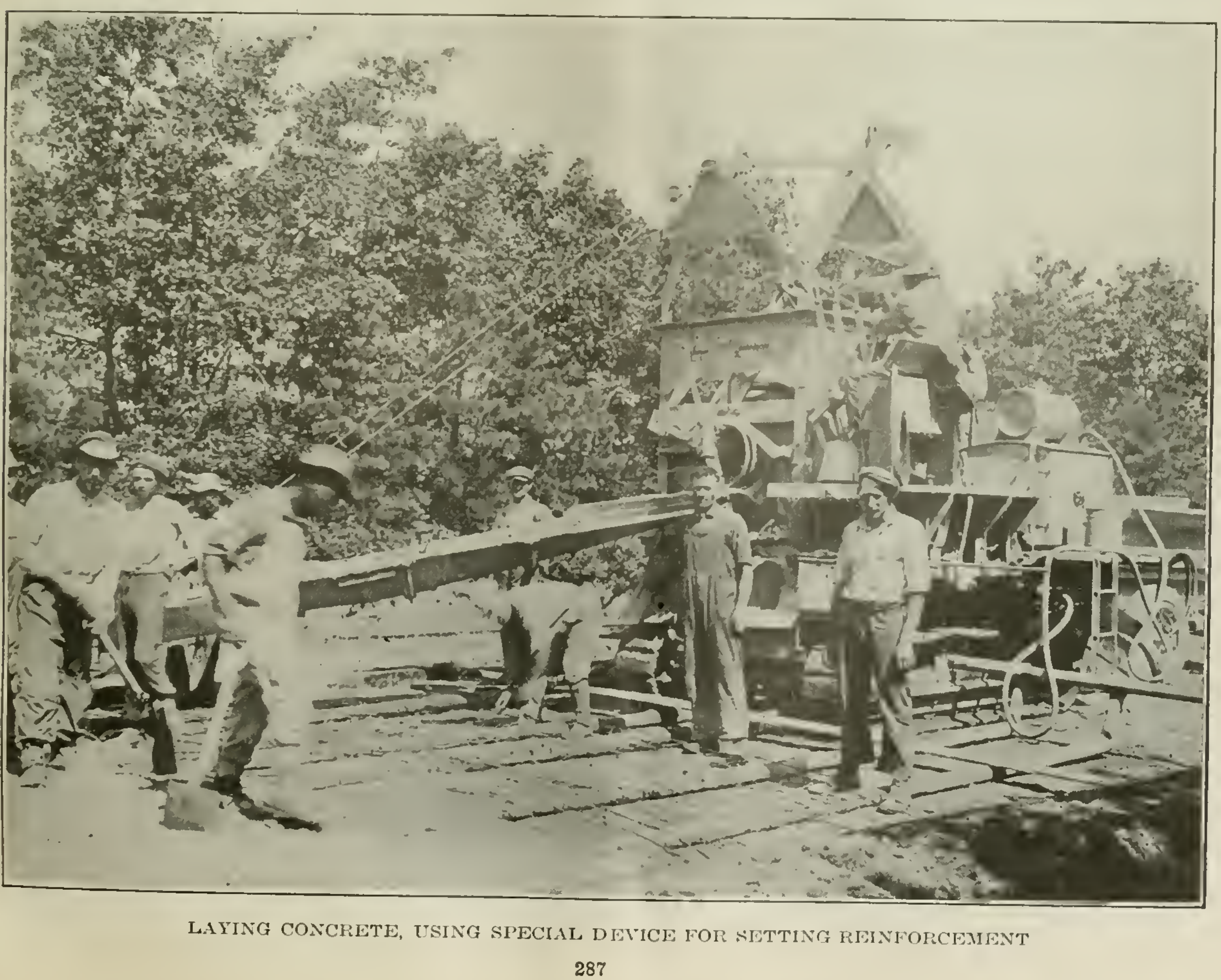
PUBLIC WORKS.
CITY COUNTY STATE
A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.
Vol. 51 OCTOBER 15, 1921 No. 16

Rapid Highway Work on Long Island

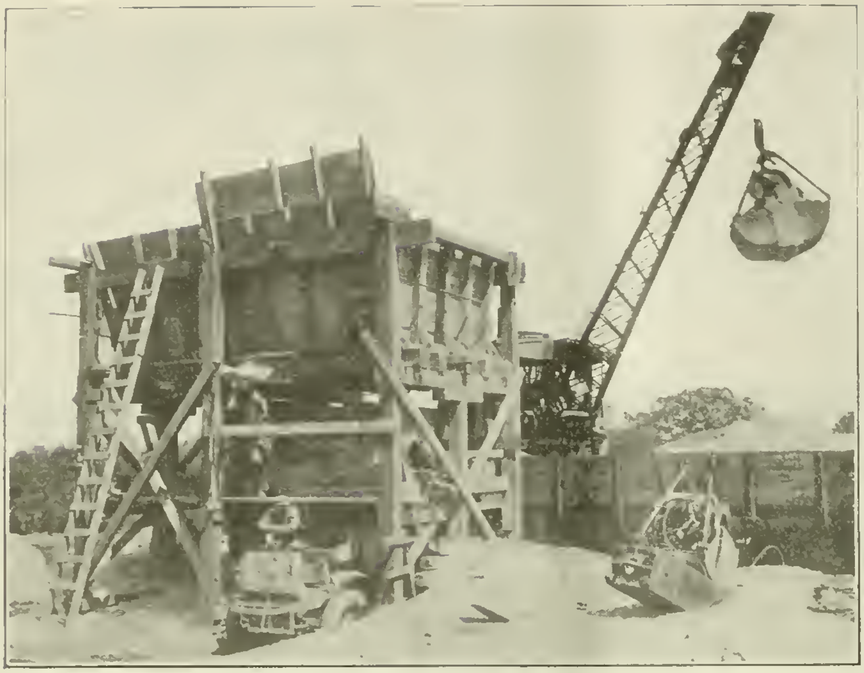
Thorough co-ordination of equipment, operations and supplies enables contractors to build a 20-foot highway 9 miles long at a maximum rate of nearly 1,000 linear feet per day.

New York State Highway 8039, from Center Moriches 9.07 miles to West Hampton, is being reconstructed with concrete surface to replace the old dirt road and some macadam on practically the same location, modified by reducing some of the grades and sharp curves.

The road passes through a rural district where the land is moderately rolling and the soil is chiefly sand, overlaid with some loam and drained by small streams. Its character is such that the concrete pavement 20 feet wide is laid directly on subgrade without the construction of any foundation course, and is drained chiefly by open earth ditches and concreted gutters alongside, and



LAYING CONCRETE, USING SPECIAL DEVICE FOR SETTING REINFORCEMENT



UNLOADING AGGREGATE FROM CARS BY STEAM SHOVEL

by concrete pipe culverts and ten concrete box culverts up to 5 x 5 feet in cross section. The limiting grade is 4 per cent, except for one short section where it has a maximum of 6 per cent. The maximum curve is 30 degrees, on which curves the roadway is extended to a width of 30 feet and banked about 7 inches.

The road has earth shoulders and is widened materially on both sides of all curves, some of which have been introduced with long radius to eliminate sharp right-angle turns in the old alignment. The concrete slab is 7¼ inches thick in the center and 6 inches thick on the edges and is reinforced with one thickness of wire mesh weighing 40 pounds per 100 square feet. The concrete is proportioned 1:1½:3½ of Portland cement, sharp, clean pit sand, and broken trap rock of 1½-inch maximum diameter.

On May 16, the contract was awarded to Wm. J. Porter & Co., of Eastport, Long Island, for $372,201 on a unit price basis. The actual construction was commenced July 7, and on September 1, after delays for rain and other causes, which left only 40 working days, the contractor had laid 27,249 linear feet of pavement and operations were being carried on with increased rapidity that, in August, indicated the completion of the job by October 10, 1921.

GRADING

The old road surface is broken up by plowing with 4-horse teams, the refuse material is removed and the surface brought to required subgrade by blade scrapers, drawn by teams. The cut averages only 6 or 8 inches and as the soil is chiefly dry sand, no foundation is required for the concrete. In some cases where grades are reduced by cutting off the tops of knolls, a softer substratum of loose sand is encountered which is generally puddled for two or three days in advance of the concreting so as to make it firm and solid to permit hauling the loaded trucks over it. When it is not solidified sufficiently for this, the subgrade is covered with plank mats about 6 feet long and 8 feet wide, that are laid down to form a temporary roadway and shifted from place to place and used as required. The grading is done by a force of about 20 men and 7 teams.

FORM WORK

Subgrade is carefully leveled and smoothed and Blaw-Knox forms are set up at least 300 feet in advance of the mixer, a total of about 2,500 linear feet being supplied for the job. They are set uniformly 20 feet apart on curves as well as on tangents to permit the work to be carried on uninterruptedly, after which the widening at curves is effected by the construction of separate strips built alongside as an independent operation and thus saving considerable delay and adjustment.

SUPPLY AND STORAGE OF MATERIALS

The broken stone, of which about 10 carloads per day is used, is shipped by water from the Hudson River Palisades to Blissville docks, Long Island City, and thence by rail 71 miles to Eastport, where it is delivered at a price of $3.85 per cubic yard, which is less than the estimated cost of opening a local gravel pit and excavating, washing, screening and delivering the gravel.

Sand is excavated by the contractor in a pit adjacent to the standard-gage siding 850 feet long, which he installed for the delivery of stone, cement and other freight from the Long Island Railroad. The pit was opened by stripping from 1 to 4 feet of loam from the irregular surface of the ground by means of an Erie shovel with a 32-foot boom and a ¾-yard clam-shell bucket. Afterwards the shovel was mounted on a wooden platform about 10 feet above the original surface of the ground, and dry sand was excavated and delivered directly to the loading bin. From 350 to 400 yards of stone and sand are handled daily with this rig.

At the present time the excavation has enlarged the pit to a depth of about 20 feet, length of 400 feet and width of 200 feet, thus carrying the sides beyond the reach of the comparatively short boom in use. As it was not considered necessary to install a longer boom or to operate a dragline bucket, a Fresno scraper has been provided that is hauled by a three-mule team and brings the fine, loose sand from the foot of the bank to a point within the reach of the clam-shell bucket, which lifts it and delivers to the loading bin at a convenient boom radius, the entire operation costing $.60 per cubic yard for sand.

STORING, LOADING AND TRANSPORTING AGGREGATE AND CEMENT

The arrangement with the railroad company allows the consignee 48 hours for unloading the cars and charges demurrage on every day that the cars are held for more than 48 hours. If the cars are unloaded in less than 24 hours an allowance is made for every car-day of time thus saved, and is applied as a credit on demurrage charges up to 6 days. So far the cars have been unloaded so promptly that all demurrage charges have thus been automatically cancelled and the contractor is able to use the cars for limited storage. They are, therefore, unloaded only about as their contents are used, by means of the clam-shell bucket operated by the steam shovel and delivering to the elevated storage bin of about 40 yards capacity, one-third of which is partitioned off for sand delivered by the same bucket from the adjacent pit.

When the stone cannot be delivered rapidly enough into the loading bin, the balance is deposited in a storage pile alongside the steam shovel, whence it is reclaimed by the clam-shell bucket whenever there is a shortage of cars. It was intended to establish and maintain a storage pile of perhaps 5,000 yards capacity, but so far* the stone has been used nearly as fast as received so that the storage pile does not average more than 300 or 400 yards. The sand, which is excavated at intervals between the use of the steam shovel for unloading stone cars, is only handled fast enough to keep the loading bin filled.

MEASURING AND LOADING AGGREGATE

The hopper bottom of the bin discharges through horizontal steel gates into a measuring car with an A-shape dump bottom and compartments holding the exact amount of sand and stone required for two batches of concrete. The car is mounted on an elevated track under the hopper and is first charged with the required amount of sand for two batches of concrete and is then pushed a few feet by hand to position under the stone bin when the other compartments are filled with stone. There is headway under this measuring car for a 2ton automobile truck to back into position under it. The car body is divided into two equal portions by a vertical center transverse partition hinged on the upper edge and locked in position by a latch. When the truck is properly spotted the attendant above fills the measuring box, operates the levers and dumps all four compartments of the box into the truck so that each compartment of the truck receives one batch of sand and one of stone.

The whole operation of filling and dumping the measuring box takes only about 15 seconds, after which the truck is driven a maximum distance of 300 or 400 feet to a position alongside a carload of cement where four men quickly empty five bags of cement on top of the stone in each compartment and the truck proceeds directly to the concrete mixer. Any surplus of cement not used as fast as unloaded is stored in a shed with a capacity of about 2,000 bags.

The cement is purchased for $2.70 per barrel, delivered, and is used at the rate of from 2,000 to 2,500 bags per day. The bags are emptied as completely as possible into the trucks, after which they are taken to the storehouse, shaken, baled and returned to the mills. Considerable thought has been expended on the consideration of a method of receiving, storing and unloading bulk cement, but the work has progressed so rapidly and so favorably under present conditions that on this job it has not been thought expedient to install a cement unloading equipment at the present time when the work is so far advanced.

CONCRETING

Concreting was commenced at a point about 2 miles east of the central storage plant at Eastport and proceeded westwardly to Eastport.

After this portion had been completed the mixer was moved to a point 1¾ miles west of Eastport and operated eastward to meet the section where work was completed. Afterwards the mixer was transferred to the original starting point, 2 miles east of Eastport, and is now continuing from there to the eastern extremity of the contract and thence will be transferred to the second starting point and complete the work from that point to the western extremity, thus providing for all the long hauls over the new concrete for a considerable distance.

The aggregate and cement are hauled by eleven 2-ton Autocar trucks, each of which made an average of fifteen round trips daily at the maximum haul of about 4½ miles. The trucks traveling over the original and new road and over the

EXCAVATING SAND FOR CONCRETE BY FRESNO SCRAPER subgrade up to the machine, turn around and back to position and dump the first batch of dry material into the loading machine skip, and move forward to clear it while it hoists and delivers to the mixer drum. The empty skip is lowered and the truck backs up again and dumps its second batch into it and moves away after a total stop of about 1 minute 30 seconds for unloading.

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*This article was written about Sept. 10th.

The 25-foot dry batches of concrete are mixed for at least one minute in a 21E "Multi-Foote" paving mixer that is mounted on a caterpillar traction and discharges through a 16-foot pivoted chute slowly swung back and forth across the whole width of the roadway as the machine advances, thus distributing the concrete in a zig-zag line, almost exactly in the position required, so that it needs very little spreading.

The mixer is operated by a gasoline motor, 4-cylinder, slow speed tractor type.

SETTING REINFORCEMENT

The rapidity and excellence of the work is notably facilitated by the ingenious method that has been adopted for exactly laying and maintaining the reinforcements in position without the use of fillers, chairs, blocks or suspension devices, liable to displacements and uncertainties. A transverse bar about 18 feet long was attached to the mixing machine and to it are hooked the curved upper ends of five 3-inch pipes spaced equidistantly and bent to right angles about 2 feet below the hooks so that they may hang vertically from the bar and allow the ends, about 10 feet long beyond the bends, to rest horizontally on the subgrade.

The reinforcement mesh in strips 6 feet wide and 19 feet 10 inches long is delivered in advance and stored in piles alongside the road until it is used, when the pieces are successively laid in advance of the concrete on top of the five 3-inch pipes supported on subgrade as above noted. The concrete is then poured between the forms and passing readily through the wide meshes of the reinforcement fills all of the space below and above the latter.

As fast as the machine advances it pulls the horizontal pipes out from under the reinforcement and the latter is held exactly in position by the 3 inches of concrete below it, while the pipes remaining seated on subgrade, continue to support the reinforcement as it is placed in advance of the concrete and thus automatically insure its proper relative position.

As the pipes are dragged forward almost as soon as the concrete is placed over them, the latter is still plastic and immediately fills the spaces left by the pipes and is thoroughly compacted by the subsequent action of the finishing machine. This device (for which patent application has been made) costs practically nothing to install and operate, requires no time or attention for moving and adjustment, is automatic in operation and is considered very efficient and satisfactory.

FINISHING

Concreting proceeds almost continuously during the entire working day, and the concrete, after being spread by four shovelers, is finished by a machine that goes over the surface twice, the first time operating rapidly without applying the reciprocating belt in the rear, and the second time operating more slowly and using the belt.

Following the finishing machine are two bridges, each mounted on two 2-wheel trucks that engage the side forms and support the men that finish the joints and score the finished surface of the concrete with transverse strokes of a wooden broom, roughing the surface for improved traction.

The joints, alternating 30 and 36 feet apart, conform to the widths of the reinforcement strips and are made with "Elastite," which is set to project one-half inch above the top surface and after the concrete has thoroughly hardened is trimmed off flush with a sharp-edge shovel.

The concrete gang includes 10 men at the mixer, 1 man operating the finishing machine, 2 men setting forms, 2 finishers, and 1 man sweeping and making joints. The joints are closed with a split wooden float 30 inches long with a 20-foot handle. Afterwards they are gone over by a man with a trowel working on the rear bridge.

PROGRESS

The average progress was unusually rapid as soon as the work was fairly under way, as is shown by the July records, which have been consistently increased since and are expected to be still greater as the length of haul and the hauling over old road decreases.

July 16th	705 feet	
July 18th	570 "	
July 19th	620 "	
July 20th	790 "	
July 21st	661 "	
July 22d	785 "	
July 23d	735 "	
July 25th	802 "	
July 26th	807 "	
July 27th	730 "	
July 28th	630 "	
July 29th	606 "	(rain 2 hours)
July 30th	780 "	
Aug. 1st	836 feet	
Aug. 2d	Rain all day	
Aug. 3d	" " "	
Aug. 4th	715 feet	
Aug. 5th	801 "	
Aug. 6th	847 "	
Aug. 8th	810 "	
Aug. 9th	733 "	
Aug. 10th	708 "	
Aug. 11th	502 "	
Aug. 12th	708 "	
Aug. 13th	950 "	

The concrete paving was completed October 8, almost exactly three months after the mixer was first started, at 2 p. m., July 7. The elapsed time from the beginning to the completion of the work included 82 week days, from which there should be subtracted 7 days, the aggregate time during which the concrete mixer was not working, giving the net period of 75 working days during which the entire amount of 47,890 linear feet, equivalent to 106,422 square yards of concrete was laid. This was an average speed of 274.6 cubic yards or about 1,428 square yards daily, although much of the work was done when the materials were hauled several miles by trucks from storage to mixer, sometimes occasioning delays in charging the machine.

The log of the elapsed time gives in detail the number of hours when the mixer was waiting for cement; when it was waiting to replace a broken casting; while it was out of commission during long movements to other parts of the route location; when it was delayed by trouble with the water supply; when work ceased on account of rain; and on certain occasions when the progress was slower on account of the very heavy sand that the trucks had to drive over on the subbase. On different occasions the mixing machine was moved 6 miles, 6½ miles, and 7 miles, while the aggregate and cement had to be hauled sometimes as much as 6½ miles. Not withstanding all of the delays 11,904 linear feet of pavement were laid between July 7and July 31, 15,378 feet in August, 15,805 feet in September and the remaining 4,803 were laid in the first seven days of October.

The equipment and operations are strictly up-to-date. The best progress so far has been 950 linear feet in one 9-hour day, which was accomplished when the materials were hauled about 2 miles. The volume of concrete placed equals 500 cubic yards for 1,100 linear feet of roadway. From every day's operation two 6-inch test cubes are made and sent to the engineers' laboratory to be broken.

As concreting is not permitted during stormy or even showery weather, it has not been considered necessary to provide covers for the dry batch aggregate and cement in transit from storage to mixer. Each morning the concrete laid on the previous day is covered with two or three inches of sand, which is kept uniformly wet with a hose for 10 days and then removed and traffic permitted. Water for this purpose and for the concrete is provided by a 6 x 10-inch Worthington steam pump and a 6 x 4 x 6-inch reserve pump delivering under direct pressure through a maximum length of about 5,000 feet a 2-inch pipe. Water is derived from convenient streams and ponds to which the pipes are shifted as the work advances.

PRINCIPAL QUANTITIES

The estimated quantities involved include about 20,600 cubic yards of pavement concrete, 200 yards of culvert concrete, 30,000 barrels of Portland cement at $3.15 per barrel, and 25,000 yards of earth excavation at $1.15.

The equipment includes, besides the plant already mentioned, a blacksmith and repair shop and a garage with two expert repair men at headquarters, where there is established a gasoline service station with an 800-gallon underground storage tank that is filled daily by the Standard Oil Co.'s service wagons and is equipped with the regular Standard Oil Co.'s metering pump. The trucks and the general service automobiles consume an average of about 350 gallons of gasoline daily. Spare parts are kept for ordinary repairs of the automobile trucks.

The work is executed by a total force of about 53 men paid from 40 cents per hour upward, with a total weekly payroll of about $2,700. No difficulty is at present experienced in securing plenty of labor, most of which is Spanish. The men come principally from New York City and live in houses furnished them, rent free, by the contractor. They provide their own cook and commissary and are contented and efficient. The work is under the charge of J. H. Sturdevant, division engineer, New York State Department of Highways, and H. T. Tuthill, resident engineer. It is in direct charge of Wm. J. Porter, his principal assistant being W. J. Anderson.

Rock Trenching for St. Paul Water Mains

Power equipment saves more than $100 per day over cost of hand work.

In many parts of St. Paul, rock lies close to the surface of the ground and it is necessary to excavate the trenches for pipes and mains for the city water distribution through solid limestone and sandstone, work that is often done in winter.

This work was formerly done by hand, but is now largely done with power equipment, which, according to J. W. Kelsey, superintendent of St. Paul water department, effects an important saving of time and money. Where blasting is required, the drilling is done with a jackhammer,

OPERATING JACKHAMMER DRILL FROM PORTABLE GASOLINE DRIVEN AIR COMPRESSOR operated with air from a portable compressor and gasoline engine mounted on wheels, which is easily transferred from place to place as required and possesses superior advantages over a heavy steam engine and boiler, or an electric motor which is often unavailable on account of the impossibility of plugging in on current.

The compressor and jackhammer drill operated by two men replace 18 men required to do the same work by hand at an average wage of $4.50 per day, thus effecting a labor saving of $72 daily. The compressor used has a capacity of 80 cubic feet of air per minute at 100 pounds pressure, which is ample for operating a standard rock drill that it is claimed will penetrate limerock at a rate of about 1 foot per minute.

The trenches are backfilled with a dragline scraper, operated by a double-drum 15 h. p. engine and a 30-foot boom. Only one man is required to operate the backfiller machine, which is mounted on caterpillar treads and replaces 3 teams and 6 men. The machine has a capacity of 640 cubic feet per hour and is capable of backfilling a trench 8 feet deep and 3 feet wide at the rate of 110 feet per hour. The total cost of operation is $40.86 per day, amounting to 0.7 cents per cubic foot of material backfilled and effecting a saving of about $30 a day over the team and hand work.

A cost analysis shows that the expense of operating the air compressor 175 days in the year was as follows: For depreciation, $582.50; for interest, $87.37; for maintenance and repairs, $50; for gasoline and lubricating oil, $380.78; for labor, $1,575; making a total of $2,675.65, or $15.29 per day.

Both the air compressor and the backfiller are operated by Novo engines, of which the water department owns five. One 15 h. p. engine is operating an air compressor; another 15 h. p. engine is operating a trench backfiller; and a third 15 h. p. engine is operating a concrete mixer. The other two are 2 h. p. Novos on pump rigs, used to pump water from trenches when laying water mains and it was on the basis of their good performance that the larger outfits were purchased which have been in use from one to two years.

Concrete Pipe in Alkali Soils

Investigations made in Minnesota indicate that concrete pipe is liable to decomposition when water in the surrounding soil contains more than 3,500 parts per million of alkali salts. Quality of concrete pipe used for Minnesota drains should be improved.

The effect of alkali on concrete drain tile and the general conditions of alkalinity in southwestern Minnesota were discussed at some length before the Minnesota Surveyors' and Engineers' Society by Dalton G. Miller, senior drainage engineer of the United States Bureau of Public Roads, and in connection with the publication of this paper in the Bulletin of the Minnesota Federation of Architectural and Engineering Societies, a further brief statement was made by E. V. Willard, drainage commissioner of Minnesota. While the facts and figures cited by Mr. Miller referred to Minnesota, the conclusions which he drew probably apply generally to all sections where there is considerable alkalinity in the soil. Below we have placed in condensed form the more salient points of these two papers.

Mr. Willard states that "today farmers and land owners of Minnesota are spending millions of dollars every year on drain tile. Much of the popularity and impetus given the tile drainage movement is due to the entering of the cement or concrete tile into the field, and there can be no doubt but that without the concrete tile underground drainage could not have made the substantial progress that has been the result." If properly made and used, concrete tile is effective in securing the economical and permanent drainage of wet lands. Conditions in certain parts of Minnesota however "appear to bar cement tile from consideration." Investigations "seemed to have proven beyond a doubt that where alkali salts in solution in the ground waters occur in sufficiently great concentration, the concrete tile cannot be expected to withstand the action of the alkalis." The Agricultural Experiment Station of the Minnesota State University, the State Department of Drainage and Waters and the United States Department of Agriculture are jointly investigating to learn all they can of the subject with a view to advising what areas are unsafe for the use of cement tile and possibly to learn how to use such tile with safety.

Mr. Miller's paper took as its basis the results of examinations of soil and water in various parts of Minnesota and Iowa and of pipe which had disintegrated, apparently because of soil alkalinity.

The alkali salts predominating in southwestern Minnesota are almost wholly sulphate of magnesium, sulphate of lime and sulphate of sodium. The acid radical of each of these salts is sulphuric acid, which, under certain conditions, is free to react with the lime and alumina of Portland cement. Samples of partially disintegrated tile from southwestern Minnesota examined chemically and microscopically in the laboratories of the Bureau of Public Roads at Washington have been found to have lost 53 per cent of the cement from the outer portion of the tile and about 30 per cent from the interior portion. One of the chief physical changes resulting from the action of sulphate waters in concrete is a cracking and checking of the surfaces exposed to this action, and a swelling of the mass, approximating 100 per cent increase of volume in some cases.

Where tile were found to have failed, samples were taken of the soil, of the water flowing in the drain, of the soil water, and of water taken in open ditches in the drainage system. These data were tabulated and analysed by Mr. Miller. From this analysis, averaging the data obtained, it was found that alkali salts in the soil water alongside the pipe were about 4½ times those in the water flowing in the drains. There were considerable departures from this average and there was found to be a wide variation in salt content of the soil water within very narrow limits. For instance, at one point soil water three feet below the surface contained 3.49 per cent alkali, while at eight feet this had fallen to 0.5 per cent. "This wide range in conditions of alkalinity within very short distances accounts, in part at least, for the fact that not infrequently single tile have disintegrated while adjoining tile apparently have not been affected."

SALT CONTENT NECESSARY TO PRODUCE FAILURE

He concludes that "it does not seem unfair to conclude from these data that, with the salt content of a drain water known, it would be consistent to expect to find soil water somewhere along the tile system that would contain 4½ times as much of the alkali salts. On this assumption, along a drain the water of which contains 1,000 p. p. m. of soluble salts, there might be found places where the soil water contained 4,500 p. p. m."

Sufficient data were not available to determine just what alkali salt content of drainage water was necessary to destroy the cement pipe, but those available "seem to indicate that failure results within a comparatively short period of time when the concentration exceeds about 5,000 p. p. m. and very pronounced failures have resulted in at least three systems in which the soil water ran considerably below this figure."

It was evident that "a close relation exists between the failure of the tile and the total salt content of the soil water in contact with the tile. Of course, other factors, such as thickness of the tile walls, difference in loading due to different depths of cuts, and difference in the quality of the concrete used in the manufacture of the tile, enter into this problem; but in general the results have been quite consistent in that no failures have been found where the alkali was inconsiderable in quantity, while the most pronounced failures have been where the salt content has been abnormally high. Also, it is well to note, the failures observed have occurred after exposure for only four years which, to say the least, leaves open to question what the result will be of the action of the waters less rich in the sulphates after a period of 6, 8, 10 or a longer period of years."

However, concrete tile in Iowa have satisfactorily stood up under field conditions for a number of years, although the alkali salt in the drainage water was found as high as 970 p. p. m., while in nearly all cases the content of the drain waters ran between 400 and 500. This would seem to indicate that where the ground water did not contain more than 2,250 p. p. m. of these salts there was little danger of decomposition of the pipe, and the pipe might be safe up to a ground water content of about 4,500. Mr. Miller, on the basis of the Iowa experience, believes it fair to assume that the danger limit for soil water lies somewhere between 2,500 and 4,500 p. p. m. Averaging these at 3,500 and dividing by the factor 4½ would indicate a drain water with 800 p. p. m. as being the limit of safety. As a matter of fact, there has been found to date but one failure where the salt content of the drain water ran as low as this and the average of the drain waters in decomposed tile investigated was 2,000 p. p. m., more than half of them lying between 1,500 and 2,500.

All this is rather indefinite, but Mr. Miller believes it safe to infer that if a drain water carries sulphates of the nature found in the southwestern part of Minnesota to the extent of 1,500 p. p. m. or more, disintegration will result somewhere along a system of concrete tile of ordinary commercial quality as represented by the Minnesota product.

PRECAUTIONS BY DESIGNING ENGINEERS

Since no method is known for rendering Portland cement wholly resistant to the action of sulphate waters, it is recommended that pipe made of cement be not used in those areas where the ground waters run consistently high in alkali sulphates. Where such dangerous conditions exist is a matter for the engineer to decide, but Mr. Miller suggests making borings at intervals of 500 feet along the main line and principal branches of the proposed drainage system and collecting there samples of soil water and determining their salt content.

The method used by the writer for collecting water samples has been to make the borings with a two-inch soil auger with an extension handle. After making a boring the water is collected in a galvanized-iron cylinder about 1½ inches outside diameter and 18 inches long. This cylinder is fitted with a small flap valve at the lower end while the upper end is threaded so it may be screwed into the auger rod. The valve should be so arranged as will permit of ready removal for cleaning. These are details, however, that any engineer can readily work out.

After the water samples are secured, comes the question as how best to make the salt determinations. For practical purposes the writer feels justified in recommending a type of wheatstone bridge which has been developed by the United States Bureau of Soils and is manufactured by the Central Scientific Company of Chicago. A bridge of this type has been used on all the work in southwestern Minnesota and checked against a great many chemical analyses. Generally, where the salt content runs between 200 and 5,000 p. p. m., the results as determined by this bridge have been within 15 per cent of the true results as determined by analysis.

The principles involved in the use of the bridge are comparatively simple and are based on the fact that the conductivity of a solution increases with the salt content. In other words, high resistance means a low salt content. Also the conductivity of a solution increases with a rise in temperature. A solution, then, is taken and the resistance measured on the bridge by checking against soils of known resistance and this resistance and the temperature recorded. By reduction tables the resistance is corrected to correspond to a temperature of 60 degrees, and then reading directly from a curve already developed for any particular area the salt content can be at once determined. In case the salt content is in excess of about 5,000 p. p. m., the solution must be diluted with distilled water until it comes below this limit. Then the content of the original solution can be computed. This sounds somewhat complicated, but as a matter of fact the bridge is not difficult of operation and to obtain consistent results requires only practice. As a check against the results it will be well to have determinations for total salts made by a chemist for about 10 per cent of the water samples.

If these recommendations are followed a definite idea can be had as to the alkalinity of any area previous to the installation of the drainage system, the reliability of the results being almost wholly dependent upon the engineer in charge of the work.

In making the borings and collecting the water samples, more than ordinary attention must be given to the deeper cuts, as it has been found that water samples taken from borings in small ridges between depressions, and in the rims surrounding depressions, quite often run much higher in alkali than do those samples taken in the depressions.

BETTER PIPE NEEDED

It is recommended that manufacturers of concrete pipe endeavor to improve the quality of the pipe so as to resist as far as possible the action of these alkali salts. "Unless there is a constant and concerted effort made to improve the product of the plants serving the southwestern part of the state, concrete drain tile will achieve a reputation that will react against all parties interested in their installation." The author does not make any definite recommendations as to how these improvements can be brought about but suggests that (1) only properly graded sand, clean and free from vegetable matter be used; (2) more coarse aggregate to be used; (3) the mix be made slightly wetter; (4) more attention be given to securing the densest concrete near the outer surface of the tile; and (5) the product in all cases be thoroughly cured before installation. He believes that "too much stress cannot be placed on grading and mixing the sand in the proper proportion."

Removing Fine Material from Sand

In casting about for sand to be used in constructing the roadway pavement for federal aid project No. 41 in California, none could be found near the south end of the project that would meet the requirement that it contain not more than 5 per cent of material which would pass a 100-mesh sieve, all the local sand being found to contain at least 15 per cent to 20 per cent of this fine material. To import sand that would meet the specifications would add considerably to the expense. Could the fine material be removed from this sand, it would be acceptable.

In this section the humidity is low and the summer temperature sometimes reaches 120 degrees in the shade, so that the sand as excavated contains practically no moisture. The engineers therefore tried a plan, which was found to be successful, whereby the fine material could be blown out of the sand. The ordinary revolving screen for removing material exceeding ¼ inch in size was used and the fine material, as it dropped from the screen to the bin passed in front of a nozzle which directed against it a current of air from a centrifugal fan. Means were provided for regulating the velocity of the air so as to remove from the falling sand particles finer than any desired limit, the coarser particles falling into the bin beneath. If the sand had been damp this probably could not have been worked successfully, but under the circumstances it has been proved to be practicable and inexpensive. The blower is operated by a belt from the gas engine that operates both the revolving screen and the conveyor which carries the sand to it.

Where the sand is not sufficiently dry to be treated in this way and abundant water is available, the finer material has been removed by washing, the fineness of the material removed being regulated by the upward velocity of the washed water.

"The Highwayman"

The state highway department of New Jersey has begun the publication of a monthly medium for reaching the public, a four-page bulletin being issued once a month which is sent free to any citizen of New Jersey upon application. So far two numbers have appeared, one for August and one for September.

The first two issues have certainly indicated a desire on the part of the department to reach the ordinary citizen and not aim their remarks solely or even chiefly at those who are concerned in road construction as an engineering or contracting proposition. This does not mean that there is no real information given, however. On the first page of the second issue a description is given of the work done by the motor vehicle department in checking up the weights of vehicles at the rate of about 250 a week, stating that 25 per cent of these are found overloaded, some of them as much as 10 tons, with the load resting on the axle and the tires flattened out so that the entire load is transmitted unsprung to the road. Another article by R. B. Gage, chemical engineer of the department, describes the use of the "Calyx" drill for taking 6-inch cores from completed concrete pavements so as to determine exactly how the pavement was actually constructed; one set of such cores showing a variation of nearly four inches in the thickness of the concrete in one contract.

The lighter reading refers in a popular and sometimes humorous vein to matters connected with roads and their use. For instance: "If you insist on speed you'll get it—sooner or later in the neck." "Statistics show more accidents on good straight roads than at bad curves. A word to the wise is sufficient—once in a great while." Another one reports J. A. Williams, division engineer, as saying: "Heard of one inspector who claimed the specifications had been changed on him—inquired if they were going to use trap rock or crushed stone."

The leading editorial starts out in a somewhat startling manner as follows:

> Say you, Gentle (?*) Reader!
>
> When I pulled a gun on you last month and held you up, I said I was going to introduce you to the State Highway Department.
>
> Now, if you're a road user (and who isn't that is anybody?) I know you've cussed "the lumpy lanes of No. I." until your breath gave out and your collar button very nearly punctured your Adam's apple.

---

*Like H--l

But it is one thing to cuss, and another to *construct*. What d'you ever *do* to help your little old State have a foot of better road?

That is none of *your* business, you say.

But hold on a minute; it is your business—because you're spending money for it. That being so, you ought to have at least a reading acquaintance with the men who are laying out these funds for you. I am introducing you to some of them, and to their work, this month, and you will hear more of them in future issues of the *Highwayman*.

It is surely so, that the more *you* know about roads, the better roads your State will have. Just send your name into the Highway Department at Trenton, N. J., and I'll hunt you up once every month and introduce you to some new member of the Highway Band; and also keep you posted on detours all over the State.

Together with the "Highwayman" is sent each month a leaflet entitled "Road Tips," which gives the monthly bulletin of the detours. The information at the head of this bulletin should be appreciated by New Jersey motorists—"All detours are posted with signs and blazed with arrows."

Some Water Works Details

Supporting cast iron pipe on saddles. Joints of lead substitutes. Materials for service lines.

An interesting paper aptly described by the title, "Some Problems Encountered in Water Works Engineering," was read before the Engineers' Society of Western Pennsylvania by W. C. Hawley, chief engineer and general superintendent of the Pennsylvania Water Co., and was published in the proceedings of that society. Some of the experiences and suggestions of the author that seem to be especially interesting are as follows:

Breaks occurring in a 42-inch pipe under normal pressure were found to have been caused by the fact that the pipe was resting upon stone or rock, and similar experiences were had with a 30-inch line also. The author therefore advises against the "provision not infrequently seen in specifications for large pipe lines, especially in soft ground, to the effect that the pipe shall be laid on one or two wooden blocks or saddles per length. Concentrating the load on one point is dangerous, and while the blocking may be made to fit the pipe so that the concentration would be less than in the case of a pipe bearing upon a rock, still it is wrong in principle. It is better to give the pipe a uniform bearing and it can be done by proper care in bottoming the ditch and backfilling.

"Cast iron pipe, especially the small sizes, should be thoroughly bedded when laid. This is a matter which sometimes is not given the attention it deserves. Many of the breaks which occur in newly laid pipe of adequate thickness doubtless occur from uneven settlement due to improper bedding of the pipe when laid. After the pipe has been laid long enough to become thoroughly bedded, a considerably higher pressure may be put upon it than would be considered safe for the weight of the pipe used."

Concerning the matter of joints, the author says: "One of the important innovations in the laying of cast iron pipe within recent years has been the use of sulphur compounds instead of lead for making joints. Lead requires calking while the sulphur compounds do not, and thus they obviate the employment of a class of labor which is always troublesome and whose work requires watching and inspection. The sulphur compounds are harder and do not squeeze out of a joint as does lead. They not only save the cost of calking, but the first cost of the material is less than lead and there is the additional saving in the digging of the large bell holes required to calk a lead joint, and the maintenance of bell holes and ditch while the joint is being calked. At present prices the saving is from 50 to 75 per cent of the cost of lead joints."

Discussing the matter of the best material for service lines, the author believes that no one material is satisfactory everywhere. "In some places soil conditions make it impossible to use iron or steel pipes, either galvanized or black, and in others they fill all requirements. Some water will rust iron pipes, and thus necessitates the use of lead, tin-lined pipes or cement-lined pipes, which are used to a considerable extent in New England. A soft water or a water containing considerable carbonic acid gas cannot safely be conveyed through a lead pipe as it is liable to dissolve lead from the pipe and cause lead poisoning. In such cases a tin-lined or cement-lined pipe should be used. A serious trouble with lead pipes has been the plumbers' wiped joints. The failure of these joints under ground is a constant source of leakage and waste. There are now on the market patent couplings so that the use of the wiped joint is no longer necessary. These couplings seem to be coming into favor rapidly."

Increasing New York's Transportation Efficiency

Owing to the failure to make many needed improvements since the close of the war and to the refusal of the New York City authorities to extend, improve or even to properly maintain existing transportation lines, the congestion of the passenger traffic in New York City has become worse and worse until it is almost unendurable and at the best, substantial relief cannot be afforded by the badly needed new construction until after a delay of years.

It is therefore most encouraging to receive the announcement published last week, that the Rapid Transit Commission, after receiving the report of its engineer, Robert Ridgway, will undertake improvements and readjustments of the existing plant that it is estimated will provide for its carrying 500,000,000 more passengers annually than at present, thus effecting an increase of about 20 per cent in its efficiency without the delay or expense of new construction, which should, however, be pushed as rapidly as possible to provide greater comfort and convenience for the passengers, to catch up as much as possible with the increasing demands, and to avoid as much as possible the future predicaments of the same character as now exists.

It is stated that within the last three years traffic controlled by the Transit Company has increased 25 per cent while the facilities have increased only 5 per cent. The new plan contemplates the operation and co-ordination of all the existing lines, including some that have been temporarily discontinued, adding some new cars, and pooling the income from different branches so that the prosperous ones can carry those that are unprofitable. Mr. Ridgway has just returned from an inspection of the rapid transit systems in European metropolis and reports that many improvements possessed by them can be advantageously adopted for New York.

North Carolina Section of the A. W. W. A.

Last month there was formed a North Carolina Section of the American Water Works Association. At a meeting at Greensboro, N. C., J. L. Ludlow, consulting engineer of Winston-Salem, was elected president; Thorndike Saville, associate professor of hydraulic and sanitary engineering at the University of North Carolina, was elected secretary-treasurer; and H. E. Miller, director of the bureau of engineering and inspector of the state board of health, was elected chairman of the membership committee.

Those present decided upon a vigorous membership campaign, with the aim of obtaining as members as many as possible of the 100 filter plant operators and water works superintendents in the state, as well as engineers engaged in water works practice. The semi-annual meeting will be held early in December, probably in Greensboro.

Study of Subway Tunnel Ventilation

The United States Bureau of Mines, in co-operation with the New York-New Jersey Bridge and Tunnel Commission, is carrying on in a mine near Pittsburgh investigations of the conditions affecting ventilation of vehicular tunnels. This is believed to be the first time a coal mine has been used for such purpose. An experimental tunnel has been built in the mine which is about 130 feet below the surface of the ground and more than 1,000 feet from the mouth of the mine, because of which it will be free from the wide temperature fluctuations and leakages of air which there would be in a model above ground. Observations will be made on the effect of temperature, rate of air flow, humidity, smoke and exhaust gases on the men driving the test cars through the tunnel.

Ten automobiles will be run at 40-foot intervals and at a rate of 10 miles an hour through the test tunnel. Meantime 21,000 cubic feet of air per minute, or sufficient to maintain a concentration of four parts of carbon monoxide per 10,000 parts of air by volume, will be passed through the tunnel. Each driver and observer in the tunnel will be subjected to examination before and after the tests by physicians and physiologists and the amount of carbon monoxide absorbed by each person during the tests will be determined by analyses of the blood before and after the test. Especially sensitive methods of making these blood examinations have been developed by the Bureau of Mines. Means are provided for giving the air in the test tunnel the heat and humidity likely to exist in the tunnel under the Hudson river during any weather conditions. The main object of the test is to determine the largest amount of the exhaust automobile gases, and more more especially carbon monoxide, in the air that a man can breathe without suffering any harmful effects.

Hiram F. Mills

Hiram F. Mills, who died on October 4 at Hingham, Mass., after a long illness, had for years been well known as a hydraulic engineer, but perhaps was best known by his connection with the sewage disposal and water purification experimental work of the Massachusetts State Board of Health, of which he had been the animating spirit. He was born in 1836 and graduated from the Rennsselaer Polytechnic Institute in 1856. Soon after the death of James B. Francis, perhaps the best-known hydraulic engineer of his time, Mr. Mills was called to take charge of the water power at Lowell and shortly after became chief engineer of the Locks and Canal Company of that city.

He became a member of the Massachusetts State Board of Health in 1886 and was made chairman of the committee on water supply and sewerage and it was chiefly due to his work in this position that the Lawrence experimental station was started. He was connected with the preliminary studies for the improved sewerage and drainage of the Boston metropolitan district, the damming of the Charles river, and other investigations more or less intimately connected with hydraulics and public health.

He was made an honorary member of the American Society of Civil Engineers in 1909. He contributed a number of professional papers to this society and others, dealing with the use of piezometers, water wheels, the purification of water and sewage, and other features of hydraulic engineering and public health. In 1917 Mr. Mills resigned his position at Lowell and moved to Hingham, where he spent most of his time in writing books on hydraulics, which it is hoped will be published for the value they will have for the profession.

PUBLIC WORKS

Published Weekly
by
Public Works Journal Corporation

Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba..$3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
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FRANK W. SKINNER, Associate Editor

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Detour Signs on State Highways

Several of the state highway departments realize the importance of detour signs and are careful to insist that such signs be placed so as to secure for those using the roads the least possible inconvenience due to the closing of roads during construction. In addition, several of them send, at intervals of a week or longer, a list of new detours for publication in local papers throughout the state. For instance, we have just received from the state of Pennsylvania a list of detours established during the past week on four highways, which are described by name and also by route number.

Some highway departments, however, seem to consider that it is none of their concern how those using the highway manage to find routes around obstructions which they make during repairing or construction of highways. For instance, an automobilist who has recently spent some time in North Carolina informed us a few days ago that he found very few detour signs in that state. On numerous occasions he had no warning of the blocking of a road by a construction gang until the work came in sight and he was directed by the foreman to return two or three miles to the nearest road by which a detour was possible. Even where a detour sign was placed at the point where automobilists should leave the blocked road, after entering the detour he found no further signs to direct him, but was left to his knowledge of the country or questioning of natives to learn how to get back to the main highway again.

It is, in our opinion, an undoubted duty of the highway department to prevent the annoying and sometimes serious delay and inconvenience caused by this failure to post detour signs. Aside from this, it would seem to be a part of wisdom on the part of the department to endeavor to obtain and maintain the good will and approval of the taxpayers of the state, inasmuch as they must be looked to for further appropriations for the maintenance of the department, and few things are more likely to irritate the users of the highways than this apparent disregard of their convenience and the repeated annoyances of experiences such as those referred to. The cost in dollars of a sufficient number of detour signs is insignificant when compared to the cost of the construction and repair work being done, and the failure to post such signs must be attributed merely to thoughtlessness or carelessness. We believe that state officials, from the highest to the lowest, should give serious consideration to this which they may have considered as a trivial matter. The inconvenience to the public of closing a road during construction is a serious matter and everything should be done to minimize the inconvenience.

How Large Construction Profits Can and Should Be Made

On the contract for the New York State Highway 8039, about 47,890 feet long, described in this issue, the contractor during the first 40 days made an average progress of 681.2 linear feet per day of a roadway 20 feet wide, thus laying 1,514 square yards or 309 cubic yards per 9-hour day. One day about a month after the construction was commenced he made a record of 950 linear feet, equal to 2,111 square yards or 431.8 cubic yards.

With a shorter haul or a little extra effort the contractor might probably before the completion of the work, have attained or surpassed 1,000 linear feet per day with the same force and equipment. This is a notable showing compared with a record of 600 linear feet or its equivalent of 272 cubic yards per day, which would generally be considered large for pavement of this width and thickness. At the average speed established during the first six weeks, the contractor would have completed the paving in about 70 days total as compared with about 80 days required for a rate of 600 feet per day.

This work has been done under ordinary conditions, with a moderate quantity of ordinary standard equipment and a total force of only 53 men with a payroll of $450 per day. The labor cost does not, therefore, exceed that ordinarily incurred for a similar job done at a much slower rate. For the first month the progress varied from about 500 to 800 feet per day. If even this maximum had been maintained constantly throughout the remainder of the job after having first been attained, it would have afforded the contractor a profit even larger than the one that he is due to make by the excellent though smaller total average finally established.

It is manifestly impossible to get maximum results immediately after the commencement of the job; according to the daily records this contractor constructed 4,131 feet during the first 6 days and by this time had apparently nearly gotten into his stride. Assuming, therefore, that six days were necessary to perfect and adjust all of his arrangements and operations, there remained 43,758 linear feet of the road to be paved and which might conceivably have been done at the assumed maximum of 1,000 feet per day, thus requiring 44 days for its completion and costing $19,800 for labor. If it had taken the ordinary time of one day for 600 feet, this part of the road would have taken 73 days and cost $32,850 for labor. If the actual average of 681.2 feet per day had been maintained continuously after the sixth day the time required would have been 64 days and the labor cost $28,800.

Thus we have an actual direct saving of labor cost of $4,050 for an average demonstrated 40-day speed and of $13,050 for the possible average speed. Besides this saving the contractor would have saved 9 days or 29 days' time for which the fixed and overhead charges would have easily amounted to $100 per day, therefore his total actual saving over the cost of 600 feet per day would amount, at the 40-day average rate to $4,050+900=$4,950 and at an average of 1,000 feet per day to $13,050+$2,900=$15,950, an amount which is entirely reasonable and practicable.

This computation demonstrates most forcibly the tremendous importance of establishing maximum progress at the earliest possible moment and maintaining it uninterruptedly throughout the job; results which can be attained in most cases by making and executing a careful schedule of operations, by insuring the delivery of materials in advance of requirements, and by the use of proper equipment and organization. This involves little or no extra cost, produces large cash dividends by shortening the time of work and reduces overhead, and releases the plant and equipment for other profitable work.

A recent report of concrete paving issued by the California Highway Commission calls attention to a record of "Fast Progress" with an average of 170 cubic yards per day laid on a 13.6-mile road, which although evidently there considered notable, is only 62 per cent as fast as the 274.6 cubic yards per day of the total actual working time that was made on the New York State Highway 8039, and the only 39 per cent as fast as the maximum speed there recorded.

Maximum Rates of Pavement Construction

How much concrete pavement can be laid in a day by one mixer and its gang? What are the principal elements entering into the securing of maximum rates of construction?

These two questions are of the greatest importance to contractors engaged in laying concrete pavement, since the answer to the first determines the amount which it is necessary in preparing bids, to estimate for interest and depreciation on plant and other overhead charges; while by finding the true answer to the latter he can lower costs and increase profits.

From time to time during the past few years claims have been made for one contractor or another that he has established a record in the laying of concrete pavements. Referring to some of these which have been published in Public Works we find that the apparent record in 1917 was set by Frank L. Cohen in Westchester county, New York, when he averaged a little more than 600 feet per day of 16-foot by 6-inch pavement, this being equivalent to 1,080 square yards or 180 cubic yards per day; his maximum being 750 feet and the average gang at the mixer being 32 men. Two years later G. P. Scharl, in Branch county, Michigan, laying a pavement of similar dimensions, averaged 593 feet a day, equivalent to 1,054 square yards or 176 cubic yards—only 2 per cent or 3 per cent less than Cohen's record; reaching a maximum of 700 feet per day and 126 feet per hour. In 1920 Elder & Co. reached a maximum of 781 feet of 14-foot pavement in 9 hours, which gives a less yardage than the two just named.

Compare with these the work described in this issue where W. J. Porter in Long Island laid a 20-foot road averaging about 6¾ inches thick and reinforced at the rate of 732 lineal feet per day, equivalent to 1,627 square yards or 305 cubic yards, and attaining a maximum of 950 feet in 9 hours, with a gang of 18 men at the mixer. This rate is more than 20 per cent greater in lineal feet than either of the previous ones and about 70 per cent greater in cubic yardage, while the maximum lineal feet per day is about 30 per cent greater. Mr. Porter used no novelties in mechanical appliances or in construction methods, although he must have used machinery and methods exceedingly well adapted to the work. It would seem that his unusual record is due to excellent organization and so controlling every element entering into the construction that there was no lost motion or lost time at any point.

Probably every contractor has equaled this record for a few minutes at a time, but Mr. Porter has succeeded in continuing the record minute after minute throughout the day, minimizing the time lost by the mixer in waiting for materials, in moving ahead and in the scores of ways whereby a second might be lost here and another there until the daily rate proves to be far below that attained without special effort during perhaps 5 or 10 continuous minutes.

Averaging the number of feet run, square yards and cubic yards (since the first determines to a certain extent the number of times the mixer must be moved and the forms laid, the second determines the amount of area to be surfaced, while the third is the measure of the material brought to and handled by the mixer), this contractor has exceeded previous records, so far as we know them, by about 50 per cent and with no greater number of laborers or greater expense for machinery than is common with such work. Any contractor who has carefully figured the large part that overhead as well as labor plays in the cost of such work can appreciate what a very considerable effect this must have had upon this contractor's profits.

All of this would seem to indicate that the day of the haphazard contractor has passed and that work and profits will go to those who familiarize themselves with the best appliances suitable for conditions in question and then use them to the best advantage, eliminating all losses of time due to lack of co-ordination of the various operations and appliances entering into the work of construction.

Possibly some contractor has made even a better record than that described this week. We will be glad to learn and print the details of any other work where the rate exceeded or equaled this.

Unemployment Measures

Latest information concerning the amount of unemployment in the country and the measures being adopted for relieving the situation. Enough public work for all who are in urgent need.

Following the calling of the President's Conference on Unemployment and especially the publishing of the preliminary recommendations of that committee, cities, counties and states in all parts of the country have been taking action more or less definite with a view to reducing the unemployment. We have received advices from various parts of the country relative to this general subject and one of the encouraging features of these is to note that so many of the larger cities are reporting that, with them at least, the unemployment is rapidly diminishing or, upon investigation, is found to be less than was formerly believed. Typical of these is the statement of Mayor Snively of Duluth, that "conditions due to unemployment in Duluth may have been a little exaggerated," although "the fact cannot be discounted that there will be suffering to a considerable degree during the cold weather and that those who are in a position to render assistance should do so." At this writing (October 12th) information that has reached the conference is summed up by Secretary Hoover in the statement that not more than 10 to 20 per cent of the reported unemployment is of a kind demanding emergency measures. That is, not more than half a million to a million need immediate work to prevent suffering.

From other sources comes endorsement of the idea suggested in our editorial of last week that general and permanent solution of the unemployment problem necessitates a reduction of wages and prices of building materials. One correspondent in Pennsylvania says: "As soon as labor gets sane leaders and wants to work at right wages there will be no need of unemployment conferences," stating that farmers' produce is rotting on the ground because wages were too high to enable them to get it to market and that houses are scarce because building wages were too high, while on the other hand the builders were idle.

In general, however, the advices tell of the organization of municipal committees or of work actually being done by cities, counties and states. As typical of the smaller places, Norristown, Pa., intends to do considerable grading this fall which would otherwise have been put off until next spring. Mayor Moore of Philadelphia said that his administration was doing everything possible to put men to work and it had let more contracts in the last few months than were ever let before in a similar period. Charleston, W. Va., reports the number of unemployed reduced about one-third within the last two months.

Ohio cities seem to have been especially active. Canton has under way nearly $1,000,000 worth of paving, water works and sewer construction; Columbus is making a city-wide survey with a view to arranging for as much work as possible during the winter, this including laying sewers and water mains with a complete overturn of workers every week or two. In Marion, Ohio, Mayor Andrews is making street repairs in small units so that they will not have to be advertised and is thus keeping busy most of those who would otherwise be unemployed. In Ironton, Ohio, city improvements are taking care of most of the unemployed, which number about 30 per cent of the local labor. Akron is building upwards of 75 miles of street improvements and will lay 14 miles of water mains, bread winners of families being given preference. Mayor Scott of Newark, Ohio, has announced that that city plans to give employment to 200 or more on city improvements. In Middletown, Ohio, the Chamber of Commerce and the city government are doing their best to rush public work, on which employment will be given to permanent residents of the city.

From several sources some suggestions that the passing of an adequate road law by Congress would greatly help matters, as was suggested by us several weeks ago. In Texas, Rollin J. Windrow, state highway engineer, says that several thousand men can be employed on Texas highway work this fall and winter if the funds are available. The highway department had laid out plans with the expectation that the usual alloting of federal aid for 1921 would be forthcoming, only to learn that a 25 per cent reduction in federal aid appropriations was contemplated. Instead of a reduction, he strongly advocated doubling the federal aid appropriation to meet the present unemployment emergency. The same ideas were expressed by Thomas J. Wasser, chief engineer of the state highway commission of New Jersey.

While most of the cities and towns in the country are organizing their local forces and especially the charitable organizations and others such as the Kiwanis clubs, Rotary clubs, etc., a new idea seems to have been suggested by the Central Unemployment Committee of Philadelphia, this being to obtain the co-operation of the Post Office Department for using the letter carriers to deliver and collect cards at all households and business establishments with a view to obtaining accurate information concerning the unemployment situation and the possibility of placing the unemployed. In the same city the council directed the Department of Public Works to increase the penalty for delaying contract work and the rigid enforcing of penalties now in force, with a view to immediately terminating the practice of some contractors of delaying the beginning or prosecution of city contracts in the hope that wages would fall.

The acting director of the Reclamation Service, Ottomar Hamerle, states that $16,000,000 could be spent economically during the winter on irrigation projects already under way, giving employment to 16,000 men directly and as many more indirectly, and that $28,000,000 more and 25,000 men could be used on other projects for which plans are complete. A loan to the reclamation fund would have to be authorized by Congress to make this possible.

Consideration of all information available seems to indicate that work is imperative for about one per cent of the population and desired by three or four per cent; and that, even if private industries can not be induced to absorb them, work for all can be found on city, county, state and federal public work; but that, to effect this, every such political unit must plan to care for its own unemployed and take immediate steps for beginning a sufficient amount of public works, in most cases only that which it may have intended postponing until next spring or later.

Salvaging Waste in Pittsburgh

Work being done by private organizations in Pittsburg in the salvaging of waste materials and at the same time furnishing employment for those temporarily out of work is described in the September number of the "National Municipal Review" by H. Marie Dermitt, secretary of the Civic Club of Allegheny county. The author states that the largest organization that has taken up this work in Pittsburgh is the Association for the Improvement of the Poor, in addition to which the Salvation Army's industrial department, the "Good Will Industries" and the St. Vincent de Paul Society are working along somewhat the same line. The first named association established nine years ago a "Men's Industrial Department," "the main object of which is to give employment to thousands of men who are temporarily out of work and to provide work for men who are not able to do full-time work because of age, crippled condition and lack of training." The apparent success obtained offers a suggestion to other cities of one method that they may employ for relieving the present unemployment.

The "Men's Industrial Department" is now self-supporting through the collection and sale of waste material, including newspapers, magazines, old furniture, bric-a-brac, clothing, carpets, rugs, shoes, etc. A building has been erected and provided with the equipment necessary for repairing and renovating old clothes, reblocking and repairing hats, with carpet looms, wood working machinery, equipment for repairing clocks, and others. An average of 14 tons of waste paper are brought to this building every day and eight trucks are in constant use collecting this and the other waste materials. Ten thousand thrift bags are distributed in homes all over the city to be collected when filled. The contents are sterilized before sorting. This department between March, 1920, and March, 1921, received a total income of $62,000, about $41,000 of which was receipts from the sale of paper stock. In addition, a part of the building is used as a hotel where lodgings and meals for hundreds of men are provided and during the same period this had a total income of $21,514 against a total expense of $17,562. The income from paper is considerably less than it was, since the price for magazine paper stock has fallen from $60 a ton to below $20 and other kinds of paper and rags proportionately. Work is given regularly to 60 men a day on the average, who wander in from among the city's unemployed or stranded men.

The "Good Will Industries," established in 1918 by the Home Mission Board of the Methodist church, has its goodwill bags distributed among 10,000 people and collected regularly, and apparently operates in much the same way as that just described. The Salvation Army Industrial Department collects an average of 4 tons of waste daily by means of 6 wagons, and this also just about pays expenses with a little balance for the latest fiscal year.

As it costs the city $9.22 a ton for collecting rubbish and waste by yearly contract, it would appear that the taxpayers are saved this amount for each ton of waste that is collected by these organizations and that the city could afford, if necessary, to contribute this amount to the support of this work whether done by private organizations or under municipal direction.

Progress on California State Highway Paving Contract

The California highway commission, A. B. Fletcher, state highway engineer, announces that Contractor H. J. Kaiser has just completed laying the concrete pavement on a section of state highway in Tehama county from Red Bluff to the northerly boundary, after a record run.

The contract for constructing this 5-inch x 15-foot reinforced concrete base, 13.6 miles long, was awarded to Mr. Kaiser in March, construction was commenced on May 21 and finished September 16. Just 98 working days were consumed in laying the concrete base of this contract, the average progress being 733 lineal feet per day, or 3.58 miles per month. Over 16,625 cubic yards of concrete were involved in the work and an average of 170 cubic yards of concrete were laid per working day.

Recent Legal Decisions

THE QUESTION OF COMPULSORY EXTENSION OF WATER MAINS CONSIDERED

The Kentucky Court of Appeals holds, Mountain Water Co. v. May, 231 S. W. 908, that where the effect of ordering an extension of a water company's pipe line to serve a resident would be to throw the company into bankruptcy, deprive the city of fire protection and those now using the water of continuance of the service, it is error to grant a mandatory injunction compelling the extension, although the franchise contract provides that no part of the city shall be discriminated against in the use of the water system. This is not a case, the court said, where a public service commission has the power to determine when and upon what terms a water company shall extend its mains for the purpose of meeting the demands of the inhabitants of the municipality. Nor is it a case where the city itself is engaged in furnishing water to the inhabitants and therefore exercises a governmental discretion with which the courts will not interfere. On the contrary, it is a case where an independent corporation exercises a franchise under a contract providing in substance that the water works shall be for the use of the inhabitants generally, and that no street or locality shall be deprived of or discriminated against in the use thereof. Under this contract it is the duty of the water company, as new streets are opened within the limits of the city as they existed when the franchise was granted, and residences are built thereon, to extend its mains so as to furnish the occupants of such residences with water. Ordinarily, a mandamus or mandatory injunction will lie at the instance of a consumer to compel a water company to extend its mains to any part of the city where its franchise requires it to operate. Topeka v. Topeka Water Co., 58 Kan. 349, 49 Pac. 79; West Hartford v. Board of Water Comr., 68 Conn. 323, 36 Atl. 786; Bothwell v. Consumers' Co., 13 Idaho 568, 92 Pac. 533, 24 L. R. A. (U. S.) 485; Hatch v. Consumers' Co., 17 Idaho 204, 104 Pac. 670, 40 L. R. A. (U. S.) 263.

The right to such relief, however, is not absolute, and the relief may be denied where the demand is wholly unreasonable, in view of the peculiar hardships and disastrous consequences that would follow. Doubtless the mere fact that the income from the extended service would not compensate the company for the cost of the extension would furnish no cause for refusing to compel the service required by the contract, if its income were otherwise sufficient, and the rights of the public would not be injuriously affected, but the circumstances here presented did not stop there. The company's franchise would expire in two years. Its income was consumed in the operation and maintenance of the plant. It had no funds on hand with which to make the extension, and was unable to borrow the money. If compelled to make the extension, it would, as said above, be thrown into bankruptcy. The case was held to be one where the rights of the few must give way to the rights of the many.

ACQUISITION OF WATER UTILITY BY MUNICIPALITY —JURISDICTION OF COMMISSION

The Pennsylvania Public Service Commission holds that it has jurisdiction to consider the application of a municipality for the commission's approval of the municipality's acquisition of the plant of a water utility, although no application has been made in a court of law in which the value of the plant and the right and financial ability of the applicant to acquire it may be judicially determined. The decisions of the commission being subject to review by the courts, the right of the water company to be heard on these questions is thereby safeguarded. An application by the Borough of Waynesboro for a certificate of public convenience evidencing the commission's approval of the plant of the Waynesboro Water Company was therefore granted.

LOCATION OF WATER MAINS

The Washington Public Service Commission, dismissing a petition of the City of Yakima for an order requiring the Pacific Power & Light Company to replace a wooden pipe line with a permanent iron or metal pipe, or lay a pipe line outside the area to be paved, holds that the commission has no jurisdiction to order the change unless it is necessary to enable the company to render safe, adequate and efficient service at a reasonable cost to its patrons. The prevention of possible injury to the pavement which may be laid over the existing main is a matter to be settled between the city and the company without the intervention of the commission. The question of the location of mains by utilities is usually covered in the franchise granted by the municipality to the utility.

INCREASE OF FIRE HYDRANT RENTALS OVER CONTRACT RATES VALID WHERE AUTHORIZED BY STATE

The Missouri Supreme Court, City Water Co. v. City of Sedalia, 231 S. W. 942, following the rule established by the Supreme Court of the United States (see Pawhuska v. Pawhuska Oil & Gas Co., 250 U. S. 394), holds that every con tract between cities of that state and a public utility is always subject to modification by the paramount power of the state, and when a change is so made it is binding upon the city; the change having been made by the state as the representative of the city. Therefore, where a city contracted with a water company for the rental of fire hydrants at a specified yearly sum, and the Public Service Commission subsequently made an order finding that these rates did not afford a reasonable return on the water company's investment, it is held that a subsequent increase, authorized by the commission, did not abrogate the contract.

NEWS OF THE SOCIETIES

Oct. 17—ILLINOIS STATE FEDERATION OF LABOR. Aurora, Ill., Headquarters, 166 W. Washington St., Chicago.

Oct. 18-20—AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION. Hotel McAlpin, New York City.

Oct. 19—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Building, New York City.

Oct. 19—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineering Societies' Building, New York City. Secretary, G. I. Rhodes, 115 Broadway, New York City.

Oct. 20—BRIDGEPORT BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Stratfield Hotel. Secretary, Arthur R. Parker, Watrous Engineering Co., Bridgeport.

Oct. 20-21—CITY PAVING CONFERENCE. Engineers Club of Philadelphia, 1317 Spruce St., Philadelphia. H. E. Hopkins.

Oct. 20-21—OHIO STATE CONFERENCE ON CITY PLANNING. Annual conference. Columbus, Ohio. Secretary-treasurer—Charlotte Rumbold, Chamber of Commerce Building, Cleveland.

Oct. 21—COLUMBUS SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Southern Hotel. Secretary, Arthur Richards, County Surveyor's Office.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS Annual convention. Southern Hotel, Baltimore, Md. Secretary. Charles Carroll Brown, St. Petersburg, Fla.

Oct. 25—ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Get-together dinner Secretary, J. T. Wikle, Fulton Bag & Cotton Mills, Atlanta.

Oct. 25—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club. Secretary, W. H. Kavanaugh, University of Pennsylvania, Philadelphia.

Oct. 26-27—OKLAHOMA SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. Oklahoma City.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary. James F. Morgan, Devonshire st., Boston.

Nov. 14-16—CITY MANAGERS' ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

Nov. 16-18—NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

Nov. 17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Society of Naval Architects and Marine Engineers. New York.

Nov. 17-18—SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS. New York.

Dec. 6-9—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 14th annual meeting. Baltimore, Md.

Dec., 22-23—KANSAS ENGINEERING SOCIETY Hutchinson, Kan.

Jan. 17-20—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

May 15-19—AMERICAN WATER WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

BROOKLYN ENGINEERS' CLUB

The twenty-fifth anniversary of the founding of the Brooklyn Engineers' Club, with Andrew T. Caldwell, president; Walter M. Meserole, vice-president; Andrew J. Provost, Jr., secretary, and Kenneth Torrance, trustee, for the first officers, was celebrated by a dinner held in the banquet hall of the Brooklyn Chamber of Commerce Oct. 8, about 250 members and distinguished guests being present.

The principal speeches, introduced by past president Nelson P. Lewis, acting as toastmaster, were:

"Engineering in the Development of Commerce," by Hon. William C. Redfield, former Secretary of Commerce.

"The Public Service Corporation and the Public," J. W. Lieb, vice-president of the Edison Company.

"Brooklyn's School of Engineering," Dr. William H. Nichols, chairman of the corporation of Brooklyn Polytechnic Institute.

"Industrial Brooklyn," T. I. Jones, president of the Brooklyn Manufacturers' Industrial Exposition, Inc.

"The Brooklyn Engineers' Club," Col. Willard T. Chevalier.

"A Word from the Older Members," William T. Donnelly.

The most delightful feature of a very pleasant evening was the presentation to past president Joseph Strachn, the best loved member of the club, who for 20 years has served it devotedly as its most indefatigable secretary, of a beautifully engrossed memorial and a very substantial financial tribute expressing the appreciation and affection of individual members of the club.

The club, organized with a charter list of 50 members, has prospered steadily and its membership of more than 400 includes many of the most eminent engineers and prominent builders and manufacturers and public officials in Greater New York.

A printed record exists of papers presented and discussed during the intervening years covering a very wide range of subjects; informal talks have been given upon a still wider range of subjects, not all upon technical lines, but all of very human interest; excursions have been arranged to many engineering works of importance and to industrial plants whose operations furnish food for thought to the organizer of business.

Since the Club acquired its own house in 1909 exhibitions have been organized from time to time to bring closely to the attention of members many matters of interest which could best be shown in that way.

The first exhibition was of the Engineering books of the year 1909, followed at intervals by exhibitions of materials and methods of construction and later, as a modest scale, a showing of industrial Brooklyn, given by this Club, which has awakened an interest of borough wide extent and, without doubt, will become an annual event in Brooklyn.

Thus from a small beginning the club has grown to an established position in the community and in the spacious house to which it holds title the members gather each Thursday night from October to June and enjoy an interchange of views, absorb new thoughts, promote friendships, old and new, and in general develop a helpful and hopeful spirit.

AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular meeting of Oct. 5 papers were presented on Rainfall and Run-Off, by C. E. Grunsky.

The Flood of June, 1921, in the Arkansas River, at Pueblo, Colorado, by James Munn and J. L. Savage, and illustrated by a large number of slides showing the damage by the Pueblo flood.

An address was also made by C. Terrell Bartlett, describing the Recent Flood at San Antonio, Texas, and was illustrated with lantern slides.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Recent meetings of Local Sections have been held since the summer vacation in a number of cities including those of:

October 1—Waterbury Branch, Shepaug Outing. Visit to the proposed reservoir site of the Waterbury Water Supply Company.

October 4—Providence Section, joint meeting with Management Division. Address on Safety Appliances by Franklin D. Warren of the American Mutual Liability Insurance Company.

October 5—Buffalo Section. Address on The Construction of a Three Hundred and Sixty Million Gallon Filtration Plant by Theodore A. Leisen of the Board of Water Commissioners, City of Detroit.

October 7—Trip to Aberdeen Proving Grounds. Joint meeting with the Society of Automotive Engineers. A demonstration of the very latest developments in the Ordnance Material at Aberdeen.

NEW YORK SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

In arranging the programme for 1921-22 the main thought has been to adhere to the principle laid down by the Section in its first year of activity—to confine itself largely to the discussion of problems touching the engineering life of the Metropolitan District. With that end in view, six of the eight meetings concern themselves with such problems.

There is, also, a continuation of last year's innovation—that of holding joint meetings with the New York Sections of the other National Engineering Societies. The Programme Committee believes that the members will favor continuance of close relationship with these Sections. Three joint meetings have been arranged, one concerned with a Metropolitan District problem (that of the Port of New York), and the others with matters of more general engineering interest.

The policy of the Section's meetings last year was to provide for sufficient speakers to fill the entire evening. This year it is proposed to have a more limited number of invited speakers, ranging from five to seven, and to allow a fair amount of time for discussion from the floor.

While the meetings are planned under the auspices of the New York Section, all members of the American Society of Civil Engineers are cordially invited to attend.

PROGRAMME FOR 1921-1922

Note: The meetings are called to order promptly at 7:45 P. M. All meetings are held in the Engineering Societies' Building, 33 West 39th Street, New York City.

October 19th, 1921—Joint meeting with New York Sections of A. S. M. E., A. I. M. M. E. and A. I. E. E. Subject, Financing Public Utilities and Large Engineering Projects. Opening address by A. B. Leach, of A. B. Leach & Co., bankers.

November 14th, 1921—Joint meeting with New York Sections of A. S. M. E., A. I. M. M. E. and A. I. E. E. Subject, The St. Lawrence Ship Channel and Power Project. This will be presented by Hon. Henry J. Allen, Governor of Kansas, and will probably be discussed by Hon. Nathan L. Miller, Governor of New York.

December 21st, 1921—The Zoning Law—What It has Done for New York. Opening address by Edward M. Bassett, counsel of the Zoning Committee and chairman of the commission which framed the zoning law.

January 11th, 1922—Traffic Handling—Its Engineering as Well as Regulatory Aspects. Opening addresses by E. P. Goodrich, consulting engineer, and Amos Schaeffer, consulting engineer to the Borough President of Manhattan.

February 15th, 1922—Removal of Solid Wastes. Opening address by John P. Leo, Commissioner of Street Cleaning, New York City.

March 15th, 1922—Joint meeting with New York Sections of A. S. M. E., A. I. M. M. E. and A. I. E. E. Subject, Port of New York. Opening address by E. H. Outerbridge, chairman of the Port of New York Authority.

April 19th, 1922—It is hoped that on this date a discussion may be had on the Hudson River Bridge, but due to certain contingencies in connection with the work of the corporation promoting the project, the meeting cannot be assured until early in the new year. Announcement will be made later.

May 17th, 1922—Need of Regional Planning for the New York District. Opening address by Charles D. Norton, first chairman of the Plan of Chicago.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA

At the recent meeting at White Sulphur Springs, W. Va., the executive board of the A. G. C. made several changes affecting the organization of the association. These revisions provide among other features for membership through local chapters, state or construction area divisions to be known as "branches," a new schedule of dues favoring the contractor doing an annual business of less than $500,000, and an increase of the board of directors from 12 to 19 and election by territory. Moreover, the board recommended that the committee on organization consider a plan creating a junior membership with limited privileges, which should include superintendents and general contractors not now eligible for membership in the A. G. C.

BRIDGE ERECTION LECTURE

At the Brooklyn Institute of Arts and Sciences, October 6th, Frank W. Skinner, Associate Editor of Public Works, and consulting engineer, delivered a popular lecture on the Erection of Long and Lofty Steel and Concrete Bridge Spans, illustrated by 100 stereoptican views, selected from his course of university lectures on Civil Engineering Construction Operations.

The lecture briefly reviewed the development of a bridge building, which since the construction of a crude arch discovered in a Theban tomb, more than 4,000 years old has passed through the stone, wood, wrought iron, cast iron, steel, supersteel concrete and combination types. It made little progress through 40 centuries up to 150 years ago when cast iron was first used for arch spans in England. Another long step was taken a few years later when wrought iron became available and in the past 30 years, since the use of steel has increased the maximum length and capacity of spans has increased many fold from a previous extreme length of 550 feet to 1800 feet already constructed, and 3,250 feet now designed and urged for a double deck, 10-track railroad and highway suspension bridge across the North River, New York.

The design of bridges has been largely influenced in this country by the economics of erection, and the methods adopted have gradually been developed into a number of principal types which were illustrated by progress views of most of the classical bridges of the world, including those across the East River, New York, the Niagara, St. Lawrence, Ohio, Mississippi and Missouri Rivers in this country and describing different methods and difficult operations illustrated by the Poughkeepsie, Manhattan, Hell Gate, Quebec, Victoria and many other great cantilever arch and suspension bridges in America, besides the famous Fourth Bridge, Gokteik and Uganda viaducts and other notable constructions abroad.

The non-technical descriptions included many anecdotes of heroism, ingenuities, and human interest. The lecture is one of a course at the Institute, that includes the subaqueous tunnels of New York and the aqueducts of New York, San Francisco, and Winnipeg.

INTERNATIONAL ASSOCIATION OF MUNCIPAL ELECTRICIANS

The twenty-sixth annual convention of the International Association of Municipal Electricians was held at Colorado Springs on September 6th to 9th. The attendance was good and a great deal of constructive work was accomplished, and many interesting papers delivered. The officers elected for the ensuing year are: President, W. R. Arbuckle; vice-presidents, first, Dr. Charles P. Steinmetz; second, J. L. Caldwell; third, D. R. Snyder; fourth, John Southwell; secretary, Clarence R. George; treasurer, William Crane; and executive committee, E. H. Benz, chairman, R. C. Turner, C. E. Convers, William G. Dey, C. K. Ahearn, F. K. Shinnen, George L. Smith, Dave Reed and H. L. Strong.

WASHINGTON STATE GOOD ROADS ASSOCIATION

The twenty-second annual convention of the Washington State Good Roads Association was held in Tacoma September 15th and 16th. The attendance was large, and those present were addressed by numerous well-known speakers on all phases of road work, including highway construction, highway beautification, road legislation, road signs, etc.

NATIONAL DRAINAGE CONGRESS

The National Drainage Congress held its tenth annual meeting in St. Paul, Minn., on September 22-24th. The most important feature of this meeting was the passing of resolutions urging more adequate state protection of settlers on reclaimed lands and the improvement and simplification of state laws affecting drainage and other forms of reclamation.

NATIONAL DRAINAGE CONGRESS

The three-day session of the National Drainage Congress was held in St. Paul commencing Sept. 22 with an attendance of more than 100 prominent engineers from different parts of the country. Percival B. Coffin urged drainage commissioners to solicit competent engineering advice to develop broad and comprehensive plans for the drainage of their districts. He said that the drained land should be laid out, planted with trees, provided with highways, and furnished with stores at convenient centers for the promotion of agricultural, business and social activities. He added that the construction engineer had never had any opportunity like that of the present for developing America's vast empire of unused land.

F. H. Newell, consulting engineer of the United States Reclamation Service, stated that thousands of acres of reclaimed land are lying idle in spite of enormous expenditures made by the government for the irrigation and drainage work because there is no proper system of colonization. These tracts have now mostly fallen into the hands of large owners who will not sell them at prices suitable for colonization. Attention should be given to the best results attained in Wisconsin and Canada where many settlers have been attracted to reclaimed lands through the interest the government takes in them.

PERSONALS

Johnson, John E., of Paducah, Ky., has been appointed highway engineer for the western district of the state highway department of Kentucky, to succeed Hugh Crozier who has been appointed assistant engineer in the headquarters office at Frankfort.

Grant, Major U. S., 3rd, Corps of Engineers, U. S. Army, has been appointed a member of the California Debris Commission.

Robinson, Capt. John K., has been promoted to be chief of the Bureau of Engineering of the U. S. Navy.

Mayes, J. B., formerly with the South Carolina state highway department, has been appointed road engineer of Williamsburg county, S. C.

Vanneman, Charles R., has been appointed chief engineer of the New York state public service commission to be in charge of the engineering and inspection work of all steam railroads, street railways, grade crossings, electric light companies and telephone and telegraph companies.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

NEW TYPE OF AIR COMPRESSOR

The Ingersoll-Rand Co. announces a new type of belt-driven air compressor known as the "Imperial X C B" in which it has incorporated several noteworthy features, including Ingersoll-Rand plate valves for both air intake and discharge, and the 5-step clearance control for regulating the compressor's output.

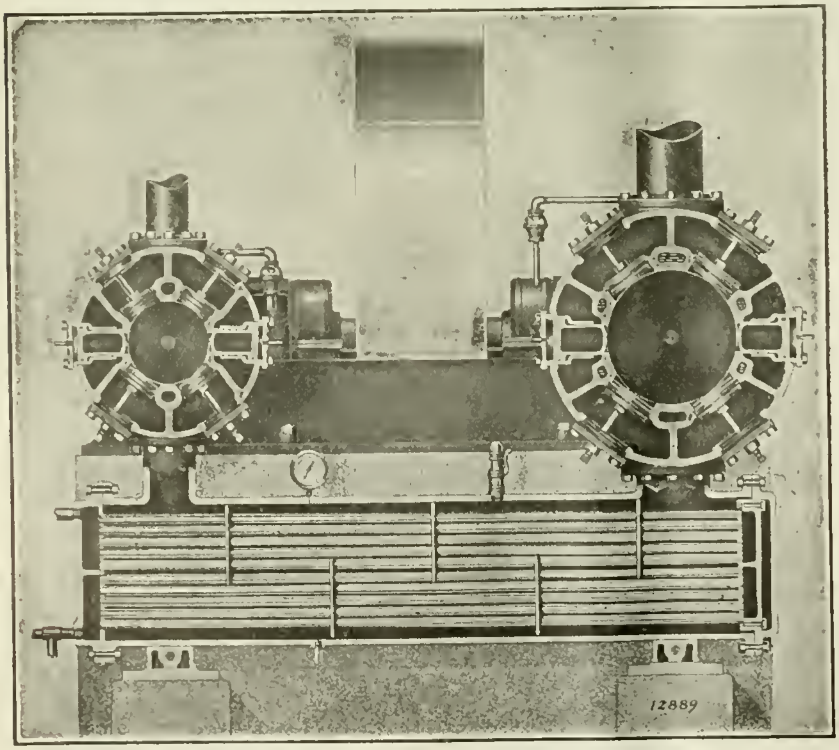
The plate valves include the features which have been proven necessary to the successful functioning of the light-weight type of valve, notably that the valve be supported throughout its entire operation in perfect alignment without any form of wearing guide, which is essential to the life of the valve.

The clearance control has been used by the same company on direct-connected compressors where it has been found most satisfactory and efficient and the use of this form of regulation is considered a most noteworthy development in air compressor design. It is a method of securing extremely efficient operation at partial loads, the compressor being automatically loaded or unloaded in five successive steps, which steps are obtained by the reduction or addition of clearance space to the air cylinders. The compressor will operate at full, ¾, ½, ¼ or no load and the design of the clearance control is such as to secure efficient operation at any one step, the reduction in output power required being practically in proportion to the reduction in output capacity, the entire control being automatic.

With this method of control there is no loss of power due to wastage of air and leakage. The clearance pockets in the cylinder are automatically thrown into communication with the ends of each cylinder in proper succession, the process being controlled by a predetermined variation in receiver pressure. With the compressor operated at partial capacity, a portion of the air is compressed into an added clearance space instead of passing through the discharge valves. On the return stroke this air expands, giving up its stored energy to the pistons. The inlet valves remain closed until the cylinder pressure equals the intake pressure. At this point the inlet valves are opened automatically and free air is taken into the cylinder for the remainder of the return stroke. Thus the inlet capacity is reduced without reducing the intake pressure. On a two-stage compressor, clearance space in proper proportion is added simultaneously for both high and low cylinders, giving a constant ratio of compression and maintaining conditions necessary for the highest compression efficiency throughout the entire load range.

Another feature of this control is a maximum demand stop, which will prevent the compressor being operated at any higher maximum load than is desired.

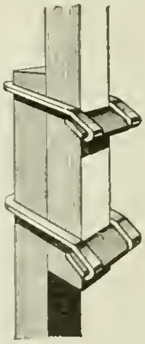
This new type of compressor can be furnished single-stage for low pressures and the two-stage for higher discharge pressure. The piston displacement capacity for 100 pounds discharge pressure ranges from 610 to 1,505 cubic feet of free air per minute. This compressor can also be furnished with a short belt drive attachment with floating idler, which secures a saving in floor space and length of belt and permits a greater arc of belt contact.



IMPERIAL X C B AIR COMPRESSOR WITH INGERSOLL-RAND INTAKE AND DISCHARGE PLATE VALVES

SCHENK TIMBER CLAMPS

The Schenk Timber Clamp consists of a U-shaped spring steel yoke with the extremities hooked to engage a transverse lockplate. The two pieces of timber to be connected are placed parallel to each other with the overlapping ends in contact and enclosed by a pair of yokes with the lockplate adjusted at an angle to the yoke. The plate is then re-yoke, thus powerfully until it is parallel and in contact with the yoke, thus powerfully tightening the latter on the timbers so that it acts as an eccentric increasing the frictional pressure between the timbers with any farther displacements and holding them securely together.



This device is strong, simple and cheap and can be rapidly attached and detached by a turn of the wrench without danger of injuring the wood. When Schenk clamps are used the timbers need not be cut to any required length, do not require bolts, nails, pins or any other connection, will not slip under heavy load, can be quickly set to the exact required height, can be assembled and removed more quickly than by any other method, are strongest at the point of connection and are not injured by making or removing the connection. Clamps are carried in stock for 3x4, 2x6, 3x4 and 4x4-inch sizes of timber.

The Blaw-Knox Company announces the addition to its staff of H. O. Davidson, who will have entire charge of the Prudential Sectional Building Department of the Blaw-Knox Company and will be also general manager of the C. D. Pruden plant of the Blaw-Knox Company. Mr. Davidson, who will be located at the C. D. Pruden plant at Baltimore, was connected for eight years with the Hydraulic Steelcraft Company, being general manager of that organization at the time he severed his connections to become a member of the Blaw-Knox staff.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 OCTOBER 22, 1921 No. 17

Constructing Sherman Island Dam

Unusually complete plant for constructing a multiple-arch dam on the Upper Hudson river. Concrete materials brought to mixer by belt conveyors and automatically proportioned by weightand entire mixing process operated by one man and distributed by another.

A power development consisting of a dam, canal, power house, etc., known as the Sherman Island development, is being constructed in the Hudson river about five miles above Glens Falls, N. Y., for the International Paper Co. by the Parklap Construction Co., of New York City, of which the firm of Parsons, Klapp, Brinckerhoff and Douglas are engineers and managers. The construction work has gotten well under way on the dam and canal and in this as well as in the design there are several features of unusual interest; chief among the latter being the spillway, while the construction features are notable even at this day for the minimizing of the use of common labor by adopting the latest labor-saving devices.

The development comprises a dam across the river, a power canal about 3,500 feet long with its headworks at the north end of the dam, and, at its lower end, a forebay, connected through 18-foot diameter penstocks to a power house for developing 50,000 h. p. This development will utilize practically all of the head still available in the river between an existing dam known as Spier's Falls about 3½ miles above, and the "feeder dam" which the state constructed in connection with the Glens Falls feeder of the Erie canal about the same distance below, this head being about 65 feet. About 20 feet of this available head is due to rapids in the river below the dam, which was the chief reason for locating the power house about 3,500 feet below the dam. The stream carries many millions of logs every spring for the use of the paper and lumber mills at Glens Falls and vicinity and provision had to be made for passing these logs over or around the dam and also during the construction of it.

The bed of the river contains boulders of all sizes to a depth of ten to twenty feet, and below this lie sand and gravel to a depth so great that it seemed impracticable to carry the dam to a rock foundation. The design adopted consisted of a multiple-arch dam about 600 feet long containing 29 full arches 19-foot span between centers and several fractional arches at the ends. The buttresses supporting the arches are themselves supported on a reinforced concrete floor slab placed on the boulder and gravel bed of the river, which was merely leveled off a foot or two below the original river bottom. The arched deck of the dam has a slope of 5 on 12 for about two-thirds its width and about 45 degrees for the upper third. The buttresses are 3 feet 6 inches thick and the arches from 18 inches at the top to 24 inches at the bottom. The total width of the dam is 104 feet, and an apron has been constructed for an additional 50 feet below the dam. In order to create additional safety against movement down stream, an anchor trench was excavated near the center line of the dam extending entirely across the river and filled with concrete cast monolithic with the floor slab and tied to it by reinforcement. The floor, buttresses and deck are all reinforced and thoroughly bonded together. In order to prevent seepage through the boulders and sand under the dam, interlocking steel sheet piles 55 feet long were driven at the upstream toe of the dam. A trench was dug along the line of the piles and filled with concrete, which is monolithic with the floor slab.

It is not intended that the dam should ever act as a weir dam, but provision for discharging surplus water not used in the power canal and floods was made by a spillway at the south end of the dam, where there is solid ledge rock for a considerable distance both above and below the dam and extending nearly to the spillway elevation. A spillway built in the line of the dam continued would have been much too short and the topographical conditions seemed best to be met by a spillway having in plan somewhat the shape of a hairpin with the loop upstream from the dam, the two legs of which are 180 feet apart and the entire length of crest about 950 feet. In the space between the two legs of the hairpin and extending

GENERAL VIEW OF INSIDE OF COFFERDAM, LOOKING FROM
At the right and left are seen the cribs that carry the industrial tracks and against which the sheet piling is braced. In
tower, bins and mixer, excavation for north end of dam and entrance to canal. In the bottom background is a form,
anchoring the buttresses. These floor strips are really straight,

downstream to the river is a channel excavated in solid ledge rock.

It is estimated that to carry the maximum flood waters of the river will require a head of 9 feet on the spillway and the velocity flowing over it will reach 38 feet per second.

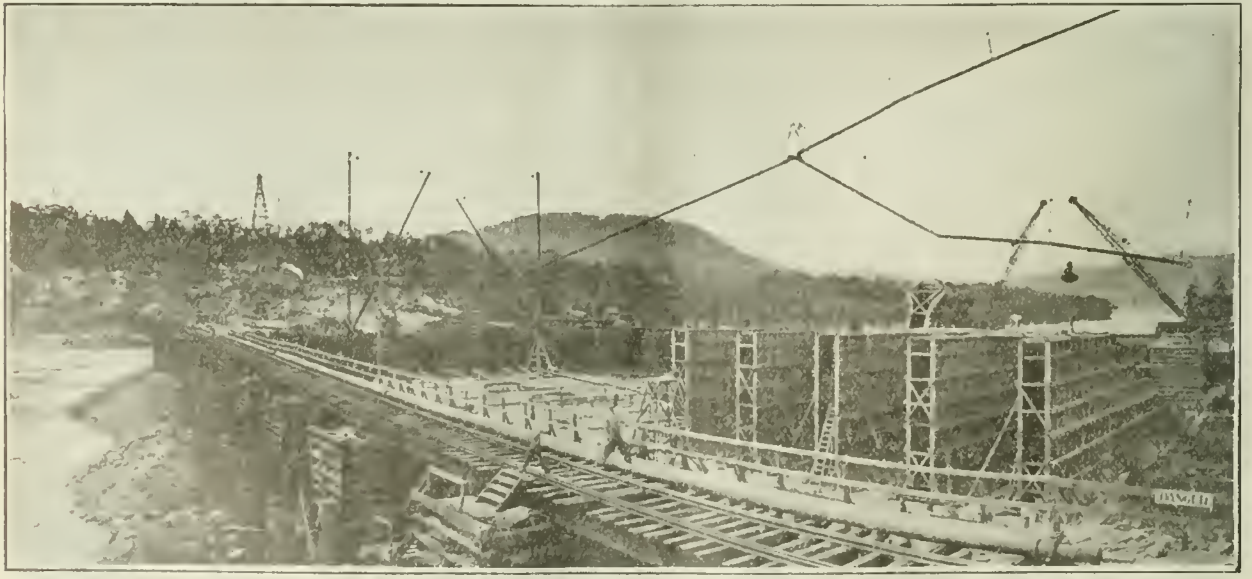
During freshets practically all of the logs in the river will pass over this spillway. At other times they pass through the power canal, provision being made at the lower end, just beyond the forebay, for discharging the logs into the river below the power house.

This canal also is unusual in that it is about 3,500 feet long, about 40 feet deep, 30 feet wide on the bottom and 150 feet wide on top and is built throughout in sand, paralleling and only a short distance from the river and 40 to 60 feet above it. The treatment of this canal so as to prevent seepage and wash and the destruction of the lining by logs passing through the canal and meet other difficulties forms one of the interesting problems of this work.

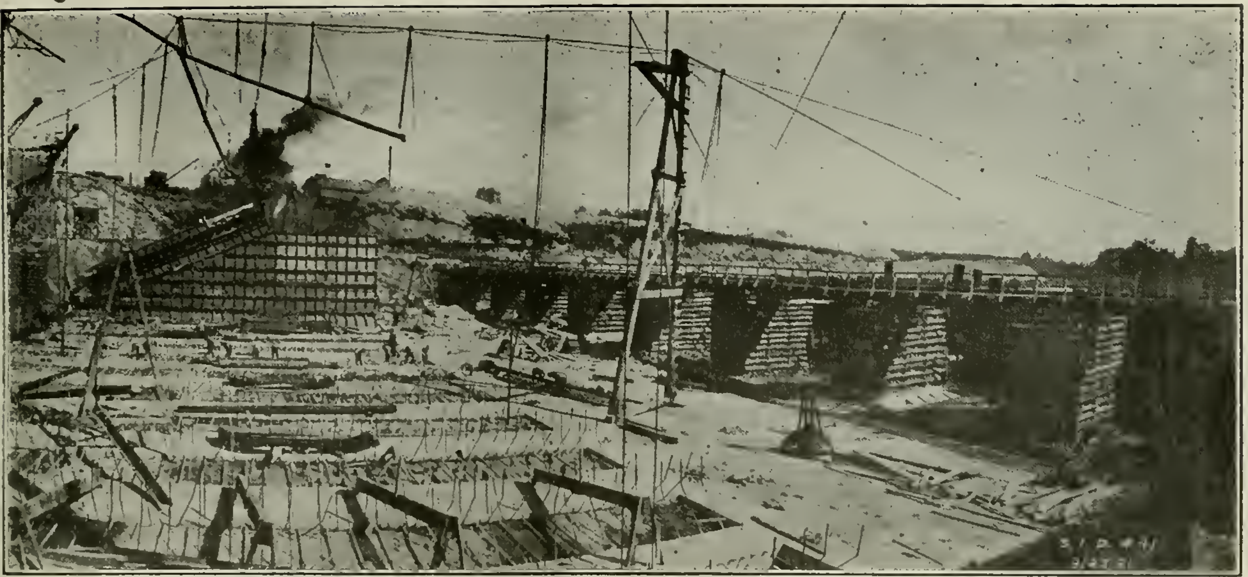
The entire development has been undergoing investigation by the International Paper Company's engineers for several years past, and some of the details are still being perfected as the construction progresses.

The power house, together with the canal, has been designed for the development of 50,000 h. p., although it is probable that mechanical installation for only 30,000 will be installed at first.

The dam is being constructed in two sections consecutively, each in a cofferdam enclosing half the width of the river. The north section is now



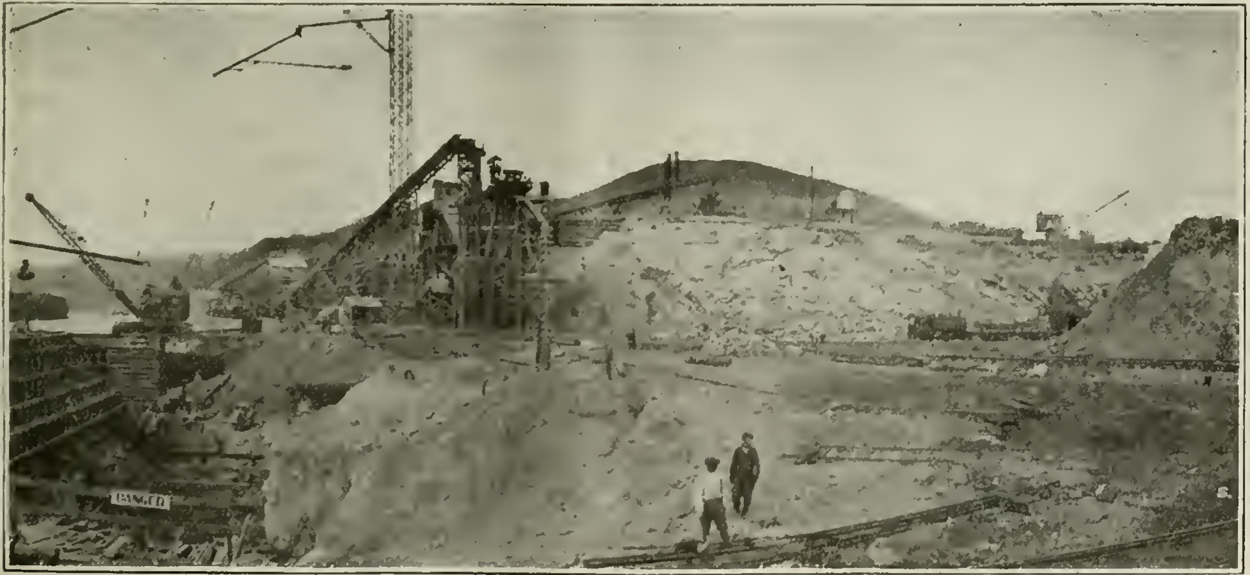
GENERAL VIEW OF DAM CONSTRUCTION, LOOKING
Construction track in foreground, paralleled by compressed air pipe. Rock excavation for spillway at left background.
chutes extend over center of cofferdam. The inclined belt conveyer leads to top of stone bin. At the right of bins
Against the hill as background is seen the



SOUTH WALL OF COFFERDAM TOWARD NORTH END OF DAM
the background are seen from the left to right, the crusher building, cement house, crushed stone conveyer, concrete nearly completed, for one of the buttresses and in front the strips of flooring between buttresses and reinforcement for but are made to look curved by the panoramic camera.

under construction while the southern half of the river channel carries the flow. Openings will be left in the dam so that, while the southern half of the dam is under construction, the flow of the river can be carried through the northern half; these openings to be finally closed at the completion of the construction. The north cofferdam, 250 feet wide by 340 feet long, was constructed by sinking 14 cribs in each of two parallel lines across the river, these being loaded with stone and sunk onto the river bottom, and six similar cribs across the end of the cofferdam. The two lines of cribs were extended entirely across the river to the further bank and served as support for two lines of track, each connecting the two sides of the river and used by the industrial cars bringing to the north side the stone excavated on the south, as well as for carrying the pile drivers, locomotive cranes and other equipment used for assembling and driving the sheet piling and later for handling the forms and other materials.

Lackawanna steel sheet piles were then driven 15 to 20 feet deep along both sides and the end of the cofferdam by means of McKiernan-Terry air-hammer pile drivers using 5,500-pound hammers. This secured a tight cofferdam with very little leakage except at one point in the end of the cofferdam where at first there was some inflow, but this was easily handled by two 8-inch centrifugal pumps and even this leakage was later reduced to practically nothing. The bottom was then leveled off and the trenches for the three cut-off walls dug, one in the center and one under each toe, and the cut-off sheet piling driven at



UPSTREAM FROM NORTH BANK OF THE RIVER
Forms for five buttresses at the right. Cable tower in back ground and cable faintly seen at top of illustration. Concrete and mixers is the entrance to the canal, on the further bank of which is the track on which sand is brought to the mixer. conveyor for the crushed stone stock pile.

the upstream toe. These sheet piles were 55 feet long and each of the two hammers averaged about six piles a day. In driving they began at the middle of this section of the dam and worked both ways, thus avoiding the difficulty of joining two sections of sheet piling driven independently.

As considerable ice as well as logs must be carried by the river during construction, additional cribs were built in the southern half of the river channel above the dam, one directly above each of the cribs that carry the construction track over the open channel and connected to it by a boom. These upper cribs will receive the blows of floating logs and jams instead of having these threaten the stability of the piers that carry the track and that will later be used for constructing the cofferdam in the southern half of the river crossing.

Before and during these early operations, a line of standard gage track had been laid from Glens Falls to the site of the dam, about six miles, for bringing in materials and machinery; a 1,400-foot cableway had been erected on towers 125 feet high spanning the river on about the center line of the dam; and houses were constructed for the superintendents, foremen and laborers employed on the work. Also the necessary trestles, bins and other structures necessary for storing and handling the concrete materials, mixing them and delivering them to the dam were being put into place.

HANDLING CONCRETE MATERIALS

The appliances for handling the cement, sand and stone, for crushing the stone and mixing and delivering the concrete are unusually complete in their labor-saving devices.

Most of the stone is obtained from excavation in the ledge rock on the south side of the river, although a little is obtained at the north side where the dam ties into the ledge rock and at the excavation for the head-gates. This rock is brought in cars to a jaw crusher 12 by 24 inches, into which the rock is dumped directly. The crushed stone is discharged onto a conveyor which carries it either to a stock pile or directly to the stone bins; except that any stones larger than 2½ inches are diverted from the conveyor to a gyratory crusher which reduced it to less than 2½ inches and discharges it onto the same conveyor. Belt conveyors are used for the broken stone, and also for handling the cement as described later. One conveyor carries the stone to an elevation of about 70 feet above the ground, where it falls onto a stock pile. Another conveyor carries it to one or the other of two stone bins which are located immediately above the concrete mixers, these bins being kept full and the surplus from time to time going to the stock pile.

All of the sand used is obtained directly from the excavation of the canal and is brought in side-dump cars directly to a point just above the sand bins, which also are set just above the concrete mixers. The sand is discharged directly into these bins through a screen which removes the gravel.

The cement is brought by rail from Glens Falls in bulk in gondola cars provided with a covering to exclude rain, and are run into the upper part of the cement house, where they discharge into bins immediately under the track, each bin having a capacity of several carloads of cement. These bins are all in one line and terminate at the bottom in a hopper and swinging valve. Immediately under these hoppers travels a belt conveyor onto which cement is discharged from whichever bin is desired. This conveyor carries the cement to and discharges it into a cement bin above each mixer.

Immediately above each mixer and below the bins is a bucket which receives the stone, sand and cement necessary for one charge of its mixer. For proportioning the mix the contractors are using an appliance which has recently been patented for this purpose and which reduces the labor required for the entire charging of the mixer to one man. By means of adjustable counter weights, the swinging gate at the bottom of the sand bin hopper, which is opened by the operator by pulling a lever, is closed automatically as soon as the predetermined weight of sand has entered the bucket. The charge of broken stone is determined in the same way by the automatic closing of the gate when the desired amount of stone has entered the bucket, and the same with the cement. The charge being in the bucket, it is dumped into the mixer by pulling another lever, one man easily performing the entire operation.

The mixer discharges the concrete into a hopper, which in turn discharges it into a bucket at the foot of a tower 185 feet high, from which it is distributed by chutes which distribute the concrete over the entire area of the first cofferdam. When the southern half of the dam is being built, it is proposed to discharge the concrete into the bucket of a second or booster tower, from which a similar system of chutes will distribute it over the southern half of the dam.

OTHER EQUIPMENT

The contractors obtain abundance of electric current from the International Paper Co. and use this directly or indirectly for practically all power except the locomotive cranes, the locomotives and a few other of the larger movable apparatus for which neither electricity nor compressed air could be used advantageously and on which steam is used. The rock crusher, concrete mixer, the machinery operating the belt conveyors, etc., are operated directly by electricity, as are also the two large Sullivan compressors which furnish air for the pile drivers, drills and some of the other apparatus. The drilling on the south side, where the channel for the spillway is being excavated, is being done with "Cyclone" drills, which sink holes from 30 to 50 feet deep at the rate of about two feet per hour. These holes are charged just sufficiently to loosen the rock without throwing it, and it is further broken up by means of jack-hammers and mud shots.

Adjacent to the compressor house is a machine shop equipped most completely with lathes, planers and other large machines, drill sharpeners and an abundance of small appliances such as hack saws, etc.

In excavating the canal a steam shovel cut was first made to a depth of 8 to 10 feet, the material being loaded onto the cars of an industrial train which ran on a track along the edge of the canal bank. Below this depth the sand was removed by a drag-line excavator. The sides of the excavation are being left untrimmed, the final trimming to be done immediately before the lining is placed.

CONTRACTOR'S CAMP

The contractor's camp contains buildings for housing about 500 men, nearly, which number is now occupying them. One hundred or so are brought from Glens Falls each morning and returned at night by the railway spur used for bringing in materials. The superintendents and married foremen occupy separate houses. There is a commissary which has capacity for feeding 400 men at one time. Water is supplied to all the houses from a reservoir in the hills above the camp, where a mountain stream is impounded. All houses have not only running water but also bathing facilities for the workmen. All the buildings are provided with sewerage on the water carriage system and this is treated in a septic tank before being discharged into the river. The greater part of the lumber used in constructing the camp as well as part for the concrete forms, of which there are an enormous number, was prepared in a sawmill erected at the site of the dam.

Of the more than 600 men employed on the work only about one-third are common laborers, since the extensive use of labor-saving machinery has reduced the need of these to a minimum. This machinery, however, calls for mechanics and other skilled workmen and the larger part of the employees are of this class, engaged in operating locomotives, steam shovels, drills, pile drivers, concrete mixers, stone crushers, in the machine shop, sawmills and office.

The manager for the contractors is E. A. Little; G. Miller is the assistant superintendent; H. L. Muchemore is field designing engineer and Fred Enander is master mechanic.

Educating the Layman

By Allen H. Wright

It has been the idea of H. N. Savage, hydraulic engineer of the city of San Diego, Cal., during the work of constructing the several units of the municipal water conservation system, to inform the taxpayers as far as possible relative to the manner in which the public funds are expended and to offer in object lesson form ideas concerning the construction work.

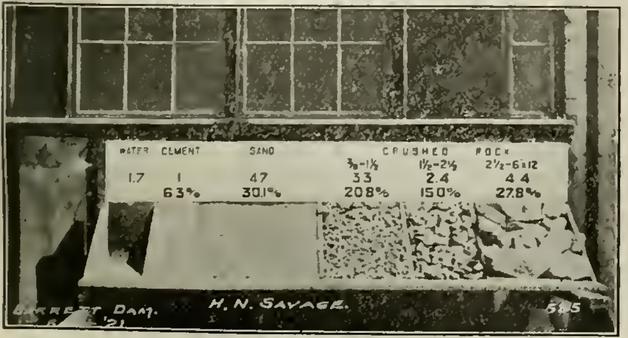


EXHIBIT SHOWING PROPORTIONS OF MATERIALS ENTERING INTO CONCRETE FOR DAM

At a recent fair held in the city of San Diego there was one simple exhibit, prepared by Mr. Savage, which told the layman unmistakably the proportion of each of the ingredients that are going into the construction of the big Barrett dam, now nearing completion.

This exhibit was so arranged that it showed to a precise percentage the amount of water, cement, sand and crushed rock which enter into the masonry of the dam, and the sections holding the crushed rock were divided into three bins, each containing the various sizes which are used. In giving the cubical contents of the several sections of the display, the amount of cement was used as the basis or 1, the water then showing 1.7, the sand 4.7, and the crushed rock 3.3, of ⅜ inch to 1½ inches, 2.4 units of 1½ inches to 2½ inches, and 4.4 of the largest sized rock, 2½ inches to 6 inches by 12 inches.

In public school work the object lesson has long been used to present a subject in a way which is understandable by all the pupils in the class, and similarly Mr. Savage's design carried his idea home to all who saw the exhibit.

Public Works in Pittsburgh

More than twenty-three million dollars to be spent on work now under way, contracted for or planned; largely streets, bridges and sewers.

Public improvements in Pittsburgh are being planned and executed on a large scale and their development is being vigorously accelerated, both to secure long needed construction, to stimulate general activity and to provide work for unemployed.

The Bureau of Engineering in the Department of Public Works is 100 per cent busy with plans, estimates and supervision of an unprecedented amount of work. A considerable amount of this is in the line of grade reductions, street widening, paving, boulevard construction and some bridge work, all of which involve a large amount of excavation and other work that can be done continuously throughout the year and provide occupation for many employees.

A total amount of $12,314,000, all of which is now under contract, is to be completed by the end of 1922. Some of this is well advanced and it is expected that $2,538,000 will be finished this year. About $942,000 of new construction contracts have been let within a very few weeks which include improvements of $90,000 for Baker street, $177,000 for Butler street, Morningside avenue and Manchester avenue, $255,000 for paving Saw Mill Run avenue, $270,000 for the Greenfield avenue bridge, $60,000 for the reconstruction of the North and Irwin avenue bridges, $90,000 for repairs to the Highland avenue reservoir, $90,000 for repairs to the Island avenue bridge. Work will soon be started on the $777,000 widening and paving of Broad street.

Surveys, designs and estimates are now being made for the construction of the $801,000 West Washington boulevard, for a $351,000 street in Hazlewood to eliminate a grade crossing there, for a $255,000 new roadway on Arlington avenue and for a $210,000 bridge on East street. All of this work is in addition to work handled by city forces that include $1,167,000 for 14.5 miles of street reconstruction, $320,000 for 8.5 miles of new trunk line and collecting sewers, $150,000 for repairs and reconstruction of steel bridges, $580,000 for 345,000 yards of asphalt paving, equal to 22 miles of roadway 50 feet wide, and $76,000 for small contracts. Besides all this it is planned to spend $6,000,000 on the construction of a subway in the congested part of the city, although the plans and surveys have not yet been made and no commission has been appointed to undertake it.

Bids have just been invited for the construction of the Beechwood boulevard bridge over Forward avenue. This will be a reinforced concrete structure of the rib type. Estimated cost is approximately $250,000. Main span about 270 feet.

The commission appointed some time ago to consider the condition of the old eyebar type suspension bridge at the Point over the Monongahela river will shortly submit a report, and it is anticipated that a new structure will be required in this location and that work will shortly be begun on the plans. The estimated cost of this structure is approximately $2,000,000.

Some of the more important improvements now under way may be described briefly as follows:

East Ohio Street—Widening, regrading and reimprovement of East Ohio street, an important thoroughfare on the northerly side of the Allegheny river, approximately one mile in length. Estimated physical cost about $300,000, involving heavy retaining wall work, cutting back of houses and building a widened street between a steep hillside and main line tracks of the Pennsylvania railroad. Location necessitates maintenance of traffic during construction. Contractor, Thomas Cronin Company.

East Carson Street—Widening of roadway and of street, from South 7th street to the Smithfield street bridge. Sole main artery on the south side of the Monongahela river, carrying all through traffic from the business section to the outlying districts on the south side of the Monongahela river lying east of the Smithfield street bridge. Work consists of widening roadway for several hundred feet and increasing width of street. Contractor, M. O'Herron Company. Physical cost approximately $250,000.

Bigelow Boulevard—General improvements. A high-speed traffic street connecting the downtown business district with the large residential districts to the east. Large retaining wall contract at cost of $300,000 just completed. Grading of hillside under way. Slip which occurred on this boulevard in November, 1920, has been restored and the boulevard relocated at this point at an approximate cost of $150,000, involving placing of 20,000 cubic yards of slag fill and approximately $25,000 for sub-drainage in order to prevent repetition of landslide. Drainage sump at foot of slide near railroad just being completed. This sump is about 30 feet in length and 16 feet long and about 15 feet in depth. The sheeting and bracing is to be left in place and the sump filled with broken stone, except for inspection manholes, and the sub-surface drainage entering same through the bottom and through holes cut into the wooden side sheeting, is being drained through two 12-inch screw joint pipe lines which have been jacked through to the face of the slope from the sump. An improved illumination system consisting of an underground conduit and semi-ornamental lights carried on steel poles is just being installed throughout the entire 3-mile length of this boulevard.

Boulevard of the Allies—Contracts have just been awarded for the construction of the Boulevard of the Allies, a new high-speed arterial thoroughfare to extend up along the Monongahela bluffs and will supplement the present Bigelow boulevard which is now overtaxed. The new boulevard will serve what is known as the Oakland and Squirrel Hill sections of the city. Estimated cost of physical contracts $1,000,000. Estimated damages $1,000,000. Work consists of widening existing streets, making heavy hillside cut into rock in the bluff along the Monongahela river and reimprovement of existing streets, and also involves two viaducts aggregating 3,000 tons. Contracts have been awarded for the major part of this work. Various contracts have been awarded to the American Bridge Company, M. O'Herron Company, Thomas Cronin Company and Dravo Contracting Company.

Riverview Park Roadways—Concrete drive has just been completed in Riverview Park, this being the first park drive of this type constructed in this city and same has been built without contraction joints. The American Association of Cement Manufacturers co-operated with the city in the construction of this drive.

Highland Park Roadway—A reinforced concrete roadway through Highland Park and extending to the Washington boulevard is now being built. Same is a 40-foot roadway with 36 pounds reinforcement and is 8 inches thick in ground. No contraction joints.

S. M. Williams Resigns as Chairman of Federal Highway Council

In a letter dated October 8, S. M. Williams, chairman of the Federal Highway Council, Washington, D. C., announces, with regret, his resignation, due to personal interests, of the position as chairman of the Federal Highway Council and expresses his desire to keep in close touch with the highway situation throughout the country and to assist in highway development whenever possible.

For four years the Federal Highway Council has enjoyed the valuable services of Mr. Williams in the constant administrative and executive duties of his office, which were performed without compensation. The present suspension of the work that he has supervised is complete unless perhaps some of various committees may be able to continue on other resources after the closing of his office.

Unanimous resolutions by the members of the executive committee accompanied the letter of resignation and testified to their unqualified appreciation of the valuable service rendered by Mr. Williams and their wish that the foundations so accurately laid by him should be built upon.

Street Cleaning in Philadelphia

As noted in these columns a few weeks ago, the city government of Philadelphia decided some time ago to begin next January the cleaning of the streets of the entire city by municipal forces under the supervision of the department of public works, following a year's experience in the cleaning of the large business section by the department. Certain local contractors have for years been performing this work, presumably at considerable profit, and are loathe to see it done by the city department and are, says Director Caven, throwing numerous monkey wrenches into the machinery through friendly councilmen or otherwise, which have seriously hampered him in preparing to take over this work on January 1. The director, however, asserts that he is more than ever determined to start city-wide cleaning of the streets on that date.

All the equipment necessary has either been bought or is being advertised for. A few days ago proposals were received for 14 to 35 5-ton trucks, for which bids ranged from $4,600 to $5,500 each; for 15 to 20 motor flushers, the bids for which ranged from $7,100 to $8,400 each; 10 to 30 motor-driven ash trucks, the bids for which were $3,600 to $6,100 each, and in addition, for tractors, snow plows and motor-driven street sweepers. Three hundred horses also were asked for, the lowest offer for these being at $137.50 each.

Director Caven has included in his plans the construction of three transfer stations where the ashes would be transferred from collecting wagons to other vehicles for removal to distant dumps. Stables and garages also would be located there. He also proposed to locate at these points incinerating plants for burning rubbish and garbage which would be provided with oil burners, so that, in case the rubbish is not sufficient to keep the temperature of the incinerators high enough to eliminate all odors, oil could be used for this purpose. The most serious difficulty which he has so far encountered has been caused by the refusal of the councilmen to accept any of the locations which he has proposed for these incinerator and transfer stations.

Refuse Incineration for Wilmington, Delaware

Capacity of present incinerator exceeded, and additional one, requiring garbage to be wrapped, and other changes recommended by John H. Gregory.

At Wilmington, Del., on August 15 of this year a refuse incinerator, specified to have a capacity of from 40 to 50 tons of average run garbage, trash, waste paper and dead animals per day, was put into the service of burning the garbage of the city and a part of the rubbish. The garbage is being collected under contract running three years beginning June 1, 1921, for which the contractor is to receive a total of $146,940. The rubbish is collected by the Street and Sewer Department of the city, as are also the ashes. Some of the rubbish is collected with the ashes and some of it is delivered to the incinerator to aid in burning the garbage.

The burning of the rubbish, however, does not provide enough heat to destroy the garbage and at the present time about five tons of coal a day are being burned for this purpose. The garbage is quite wet and, owing possibly to the limited amount of rubbish burned with it, the furnace is disposing of only about 36 tons a day, which appears to be approximately its capacity. As the population is estimated at 105,000, it seems probable that the total amount of garbage and rubbish is over 80 tons a day. It is quite evident that the present incinerator is by no means capable of disposing of all of the rubbish and some other provision for disposing of the remainder is imperative.

At the request of Mayor Leroy Harvey, Professor John H. Gregory has reported upon the subject, under date of September 26, and from this report the following facts and recommendations have been obtained.

PRESENT PROCEDURE

The garbage is required to be collected at least three times a week from June 1 to October 15 and at least twice a week during the remainder of the year. The garbage so collected is being taken to the incinerator and, as stated above, only about half of it is burned and the remainder is disposed of by dumping on ground nearby. The amount of garbage being burned is estimated at 26 tons and the combustible rubbish at 10 tons. The force employed at the incinerator consists of a superintendent and nine employees. The expense of operating the plant is now $7.50 a day for superintendent, $31.50 for labor and $36 for coal, a total of $75 a day or $2.08 per ton. Mr. Gregory states that the incinerator is new and is not running to best advantage when handling wet garbage such as is delivered to it, nor is the most being made of the fuel value of the rubbish.

As illustrating what can be done in incinerating garbage when the latter has been drained and wrapped in paper (concerning which more later) he cites the case of Trenton, where the costs of incinerating garbage and rubbish for 1920 averaged $.09 a ton for superintendent and clerk, $.44 for labor, $.18 for coal and $.02 miscellaneous, or a total of $.73 a ton. Part of the salary of the superintendent and clerk is charged against collection, since they have charge of this as well as of incineration, but charging all of the superintendent's salary to incineration as is done in Wilmington would increase the cost to only $.80 per ton. In Trenton an average of a little over 50 tons a day is burned at the incinerator with about half as many men as are employed at the Wilmington plant.

RECOMMENDATIONS

Professor Gregory makes explicit recommendations for the treatment of the refuse disposal problem in Wilmington, accompanying them by a clear and concise explanation of his reasons therefor. He recommends that the householders be required to thoroughly drain the garbage and wrap it in substantial paper and deposit it in this form in suitable receptacles for collection; that combustible rubbish be fastened together by tying or otherwise; and that this and wrapped garbage be collected together in one set of wagons three times a week throughout the year and be disposed of by incineration, utilizing the existing incinerator to its capacity and building an additional incinerator immediately adjacent to it, the new incinerator to have a capacity of not less than 50 tons of wrapped garbage and rubbish per 24 hours. The new incinerator should have a combustion chamber and a high masonry chimney, neither of which are found in the present incinerator. He recommends that arrangement be made with the present contractor for a financial adjustment whereby he will collect both garbage and combustible rubbish and that, on the termination of the contract with him, such material be collected by city employees with city-owned equipment; the collection and disposal both to be placed under the control of a single superintendent with headquarters at the incinerator. Accurate records should be kept covering the cost and other details of the collection and disposal of the mixed garbage and rubbish.

As to the other refuse, the city should continue to collect ashes by city employees and dispose of them by dumping on low land, the dumps to be kept properly trimmed, in sanitary condition, and the tops covered with clean ashes, this including any private dumps as well as the municipal dumps. Privately owned and operated dumps should be under municipal supervision and control, and all scavengers removing and disposing of material other than garbage and combustible rubbish should be licensed and under municipal control. No garbage or combustible rubbish should be permitted to be disposed of at any dump, and no fires should be permitted at any dump whether privately owned and operated or owned and operated by the city.

DRAINING AND WRAPPING GARBAGE

Explaining his recommendation that the garbage be wrapped, Professor Gregory reports that "it is simpler, easier and less expensive to operate an incinerator burning a mixture of garbage and combustible rubbish where the garbage has first been drained of its free water and then wrapped in paper, than an incinerator burning simply wet garbage either with or without the burning of the rubbish."

"The draining and wrapping of garbage is not new and has many advantages, not only from the standpoint of disposal but also from that of the householder. Among these advantages may be mentioned, especially, the practical elimination of garbage odors on the premises; the elimination of the fly nuisance, as flies breed in garbage if the same is accessible to them; the ability to tranport the material in wagons through the streets without causing offense to passers-by; and the greater ease and economy in disposing of the material by incineration.

"One of the very best examples of the draining and wrapping of garbage, its collection with the combustible rubbish, and the disposal of both by incineration is the city of Trenton, N. J., population about 120,000, where this method of collection and disposal is in use and has been practiced very satisfactorily and economically for the last ten years."

"With a change from the present method of collecting wet garbage and dry rubbish separately to that of requiring the garbage to be drained and wrapped and collected with the combustible rubbish, I see no reason why the cost of incineration at Wilmington should not be very materially decreased and approach, if not equal, that at Trenton."

Concerning municipal collection, he says that "the householder will receive better service than when the work is done by contract."

METHODS OF DISPOSAL

In the report, the various methods of disposing of refuse are discussed and compared. Concerning feeding to hogs he says: "Some revenue may be derived from the sale of garbage-fed hogs, but feeding to hogs is, however, advantageous only where the conditions are such that the food value of the garbage can be safely guarded and maintained and where sanitary conditions can be maintained at the hog farm. These conditions generally exclude it from adoption in cities of any size, and but few cities having a population of over 50,000 have found the method satisfactory."

Relative to dumping garbage, trench burial, plowing into the soil and dumping into large volumes of water, he cites the objections for adoption by large cities that are familiar to those who have informed themselves on the subject.

Concerning reduction, the report states: "From a financial standpoint, no matter whether the reduction works are privately or municipally owned, it means entering the commercial field and in competition with other similar plants. The works themselves are expensive to build and operate, and unless the grease and tankage can be sold at good prices and a financial return thereby derived, the cost is prohibitive. At the present time the price of grease is low and tankage is almost a drug in the market. How long this condition will last it is impossible to predict. One works which I have in mind is having great difficulty in selling its grease, even at a low price, and it is impossible to sell tankage, the latter simply being taken out on the lot and dumped on the ground. It doesn't pay at present at these works to recover the grease from this tankage by the naphtha process and the evaporators are not in operation.

"With a continued high cost of labor and material, it is not probable that reduction works can be operated, even with the sale of grease and tankage therefrom, other than at a loss."

Discussing the disposal of rubbish, he states that dumping is generally satisfactory provided the materials will not cause future trouble and if sufficient land is available. But fires are frequently started and the odors produced by them are often quite offensive, in addition to which the fire may be a source of considerable annoyance and even danger. Dumps containing rubbish have been known to stay on fire below the surface for days and any buildings on or immediately adjacent to the dumps may be endangered. "It is a serious question whether a municipality should allow the disposal of combustible rubbish on dumps, either publicly or privately owned, on which, even in the more or less remote future, buildings are liable to be erected." Moreover, a rubbish dump affords a good breeding place for rats and vermin and the wind may scatter disease germs brought to it in sweepings and other materials from sick-rooms. Incineration is the most sanitary method of disposing of rubbish.

Maintenance Of Sand-Clay Roads

Methods employed at Southampton, N. Y., for utilizing bituminous materials for this purpose. Three different methods, depending upon the condition of the road.

It would not be economically wise for localities which have large mileages of sand-clay roads to attempt replacing all these roads with the higher types of surfaces. In fact, it would be a financial impossibility. The construction of higher types has to come along gradually, and in the meantime the maintenance of the lower types must continue. These less durable types, when properly maintained, however, offer splendid wearing surfaces for automobile and light truck traffic.

Many localities lack suitable stone for road construction, and in a large number of these places the cost of importation of stone is prohibitive. It is necessary, therefore, to use local materials, which, when properly mixed, will make a suitable surface for the traffic it is to bear. But in the case of many classes of roads using local materials, a system of continuous maintenance must be employed to insure their usefulness to the community.

An illustration of this is found in the town of Southampton, Suffolk county, New York. For many years Southampton has been the summer social mecca around New York. Southampton and adjoining villages, therefore, had to provide means of communication for pleasure travel and light trucking.

Confronted by the total lack of local stone and the impracticability of importing it, the authorities of Southampton turned to such materials as were locally available, and used them in maintaining their sand-clay roads in excellent condition.

After extensive investigation and experiment, it was found that a mixture of 80 per cent of the coarse sand found in large deposits in the vicinity, with 20 per cent of the top soil loam, would make an excellent mixture for road construction. Fortunately, the beach sand which forms the subsoil of most of that section of Long Island provides excellent drainage for the foundation, without requiring additional work except for occasional cross ditches in heavy cuts.

BUILDING HIGHWAY SYSTEM

So eight years ago a system of highways was constructed throughout the town. After the sand sub-grade had been properly graded to width, the gravelly sand and loam were hauled and deposited in place and mixed by means of harrows. After being rolled, the contour of the road was subse-

MONTAUK HIGHWAY AT WATERMILL, SOUTHAMPTON
This highway was treated with Texaco road oil in the Fall of 1919

MONTAUK HIGHWAY BETWEEN WATERMILL AND BRIDGEHAMPTON quently maintained by the systematic use of horse-drawn blade graders which threw the loose material from the sides into the depressions formed by the traffic on the crown of the road.

About the time of the construction of these roads, the use of automobiles in that territory began to increase in remarkable numbers so that some means had to be taken to maintain the surface, which would be rapidly scattered to the gutters by the passing machines. This characteristic of the roads is particularly noticeable in sections which are not so well maintained because of the light traffic they have to bear.

To maintain the surface, a system of oiling with cold asphaltic oil was adopted in practically all the towns of Long Island, Southampton being the pioneer. The open surface of the road readily absorbed the asphaltic oil, but left numerous puddles in the depressions where greater compression had been caused by traffic. By filling the depressions with scrapings from the elevations, a uniform surface was obtained.

THREE OILING METHODS USED

As the traffic increased and experience was gained in the use of oil for maintenance, three methods were developed, their use depending on the condition of the road.

The first method used was when the road surface had not been previously treated or where excessive traffic had destroyed its contour. In such cases the contour was restored by grading the loose top surface to the sides of the road. This partially fills up the deeper ruts along the shoulders and provides material for covering the oil after it is applied. Oil containing from 50 to 60 per cent of asphalt is applied by horse-drawn pressure distributor at the rate of about ¼ gallon per square yard. Instead of shoveling the top dressing back over the road, the grader is reversed and the material in the gutters is thinly graded back over the oil in several trips so that each successive trip completely fills up any depressions created by the traffic after the oil has been supplied. This permits the oil to dry out slowly and maintains the contour so that when complete evaporation is attained and the surface is hard as the oil will permit, the contour of the road is practically perfect.

Another method is used when the road has been so maintained that the oil surface is good, covering practically the entire roadway, and the contour is perfect except for isolated depressions. Then the road is not swept or graded before the application of the oil. The character of the surface prevents any accumulation of dust, so that when the oil is applied it adheres to practically the entire area. In this case small amounts of coarse sand are distributed by shovels over the surface to take up a part of the oil, which is distributed at the rate of ¼ gallon per square yard. The sand is not spread, however, so as to completely take it up and prevent the revivification of the old surface.

Where grooves occur in the road, patching is accomplished by a mixture of sand and cold oil. This is troweled in somewhat after the manner of applying a mastic.

The third method employed is when, as the result of the continuous application of cold oil for a number of years and covering with sand, the surface of the road becomes a mat about 1 inch thick; and when, from excessive traffic or other circumstances, it becomes somewhat roughened or the contour is destroyed beyond the possibility of repair by the other two methods.

In such cases the entire surface is scarified by means of plows or scarifiers to the depth of 3 inches and harrowed in place. This rough surface is then graded to the proper contour with blade graders, rolled with a steam roller and oiled at the rate of ¼ gallon per square yard. The oil is covered, as in the first method, by grading up from the drainage gutters excess material from the old road.

To take off the water from the surface of the roads where there is practically no side drainage or the road is level, a series of deep holes are dug a short distance off the side of the road down to the sub-grade so as to permit surface water to drain off rapidly.

Repairing French Roads

It is reported that the French government has improved 13,620 miles of the 33,000 miles of roads in that country which were in need of repair at the close of the war, and that 2,200 miles have been completely reconstructed with durable pavement. In doing this work the government has adopted the policy of open competition between various types of construction with a view to testing out such standard constructions as concrete base with asphalt surface, bituminous base with asphalt surface, waterbound macadam with bituminous surface, etc.

Distilled Water for Toledo Water Works Power Plant

The Department of Public Service of Toledo has decided that the water furnished by the public water works plant is not good enough for its own use, and contracted in September for a Griscom-Russell distilling plant to be used in obtaining pure water for the boilers at the Broadway pumping station of the water works at a cost of about $10,000. This is the first plant of this kind to be installed in Toledo. It is estimated that the cost will be returned to the city in two years in the saving that it will effect in fuel consumption and cost of cleaning boilers and making repairs by the elimination of scale in the boilers.

Advises Reducing Drainage Work

At the Drainage Congress in St. Paul a few days ago, S. H. McCrory, engineer of the Department of Agriculture, advised against beginning new drainage projects of any magnitude for the next few years, since utilization of lands already drained has not kept pace with reclamation work. The present low prices of farm products and the general business depression have tended to decrease temporarily the demand for such lands and Mr. McCrory advised therefore that new work should be undertaken only where there is a definite demand for the land and a strong assurance that it will be put to agricultural use.

PUBLIC WORKS
Published Weekly
by
Public Works Journal Corporation

Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba.$3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

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Good Roads and the Railroad Strike

Should the threatened railroad strike take place, it is probable that the public will receive a striking demonstration of the direct value to it of good roads for other than joy riding purposes. For plans are under way for calling into service 100,000 or more trucks for keeping cities supplied with food; and without fairly good roads into all the farming districts surrounding each city, these trucks could not be used to advantage. In fact, it is doubtful if the million trucks in service in this country would have been built had not the construction of good roads progressed as generally and rapidly as it has.

Assuming that the truck capacity of the country averages two tons, with each truck making an average of one trip a day in covering an area of 150 miles around each city, 100,000 trucks could bring in each day eight pounds for each of the fifty million residents of cities, which is at least twice the average amount of food required. It would, in fact, be ample for all private needs except fuel. As for transporting raw and manufactured products to keep the various industries going, much can be done in this also by use of motor trucks.

Should railroad transportation be seriously restricted, there seems to be little doubt that the highways on which so many millions have been spent will justify that expenditure for such emergency purposes alone.

Labor-Saving Devices on Public Work

The elimination of common labor in concrete construction would seem to have been carried to almost the limit in the dam construction described in this issue. It would appear that only seven men are employed in crushing the stone, transporting the stone from the crusher and the sand and cement from the cars to the mixers, operating two large mixers and distributing the concrete to the forms at the rate of more than 500 cubic yards a day; except for the one or two men needed to keep the motors in repair, the conveyors operating, etc.

In this case labor is rather scarce and refuses to take reductions in wages, and "labor troubles" threaten all kinds of large public work. On the other hand, it was stated in the October 1 issue of Public Works that in Martinsville, Va., labor-saving devices are being used to a less extent now than during the previous year or two because labor has become abundant and cheap. These two cases tell the story. Labor-saving machinery costs money for purchase, operation, maintenance, depreciation, storage, transportation, etc., and when this total overbalances the total cost of labor, both direct and indirect, labor will be given the preference.

But in estimating the relative costs, the indirect costs of labor should not be overlooked. The chief of these are the overturn, and losses incidental to strikes, walkouts and other uncertainties as to the continuous maintenance of gangs of uniform size and satisfactory experience. A strike of a few days or weeks might easily cause a loss to a contractor in overhead, wages to retained but unoccupied foremen, interest or rental of plant, floods occuring after the date when the work could have been finished, and scores of other possibilities that would total much more than the cost of the machinery.

Almost any labor-saving device ceases to be money-saving when wages fall below a certain point. On the other hand, any satisfactorily operating device is money saving when wages rise beyond a certain height. Labor has it largely in its own hands to determine to what extent its demand for high wages and generally threatening attitude will lead to reduction of the number of laborers employed by the partial substitution of machinery.

There are other advantages of some machinery besides those mentioned. It often is of such nature as to insure greater uniformity of product; for example, machine vs. hand mixing of concrete. The same machine is also an example of the greater speed attainable than would be practicable by hand labor alone, and speed can be translated into dollars and sometimes into large sums.

In addition to the advantage that can be figured in dollars, there is no doubt that many contractors consider mechanical substitutes for day labor desirable because of the greater freedom it gives them from the uncertainties of labor. Many contractors have felt, during recent months, that until a job is finished the labor problem is a sword of Damocles hanging over their head, and anything that strengthens the thread that suspends it will do much toward saving them from nervous prostration.

There is still another consideration that agrees for more general use of machinery that partially supplants day labor. Very little of such labor in this country is drawn from the children of immigrants, but most of it is foreign-born. Graduates of our public schools do not take kindly to pick and shovel but may to running excavating machines. But with the number of immigrants that will be admitted in the future limited to a fraction of those that entered annually before the war, when public work reaches normal dimensions again the pick and shovel men who die off or change their occupation will be only partly replaced, and the deficiency will naturally encourage if not necessitate the more extensive substitution of machinery.

All of which leads to the conclusion that the wide-awake, successful contractor must keep himself familiar with the labor-saving machinery available for his work, and carefully calculate, for each job, how much of it he can use to advantage.

Native and Foreign-Born Birth Rates

The matter of immigration has received considerable attention in this country during the past year and is being restricted by federal laws limiting the number to be admitted each month to a certain percentage of the present population of each nationality in the country. There is a fear, for which there is undoubtedly considerable foundation, that immigration to this country, if unrestricted, would bring in foreign blood and foreign ideas faster than they could be educated to American ideals or assimilated with the American population.

This danger would seem to be increased by another condition which tends to act in the same direction. This is the much higher birth rate of foreign-born residents in this country—that is, the recent immigrants—than of the native born, and especially those whose families have been in this country for several generations. The vital statistics for the year 1920 of Montclair, N. J., a suburb of New York, which contains a high percentage of families whose ancestors for several generations have been Americans, show that the birth rate of the foreign-born whites in the town (a large percentage of which are Italians, with a number of Slavs and a scattering of other European nations) is almost exactly seven times that of the native born whites, or 85.0 for the former as compared to 12.2 for the latter. Assuming that immigration was shut off entirely and that the tendency indicated by the above figures continued at a rate decreasing about, say, 25 per cent each generation, it would not be many years before the direct descendants of the present native-born population would be completely overwhelmed by those of the recently imported Europeans.

We make no attempt to draw any conclusions from this or to imply whether such result would be advantageous or otherwise; except to state that, if the present citizens of American ancestry are to see what they consider to be American ideals continued in this country, they must pay even greater attention to the education and training in American citizenship of the children of these foreign-born parents.

Wage Reductions

Recent advices report that there is prospect of immediate resumption of building in Pittsburgh after a four-year delay, caused by industrial disputes, unfavorable conditions, and unreasonably high wages. Considerable reductions have been made in the price of building materials, the unions and the contractors are desirous of resuming work and the carpenters' union, with about 4,500 local members has accepted a 25 per cent cut by subscribing to a two-year agreement for a $1.00 per hour wage. The other building trades are expected to fall in line with the carpenters in negotiations with their employers. It is claimed by different officials that builders have promised recognition of the union.

In Dallas, Texas, where a few weeks ago contractors, engineers, real estate men and others convened with the Chamber of Commerce and agreed to suspend all operations until the outrageous wages were reduced, the bricklayers, who were then receiving $12.00 a day and demanding more, are glad to accept $10.00 or less, carpenters have been reduced from $8.00 to $6.00 and common labor from $.50 to $.25 per hour.

Bricks which formerly cost $30.00 per 1,000 can now be purchased for $12.72 and the Open Shop Association, which never before advised the public to build, now states that the time is most favorable and urges the city of Dallas to take advantage of low prices, which may not continue indefinitely.

Highway Work In Wisconsin

It is reported that the entire highway construction program of the state of Wisconsin for the year will probably reach practical completion by November 1 and that it will be at least two years before another program as comprehensive as that of this year can be carried out. Nearly 350 miles of concrete highways, all but 80 miles from county bond issues, have been constructed. One thousand, five hundred miles of road, largely state trunk highways, has been given a gravel surface and 1,660 miles has been graded. About $24,000,000 has been spent on road construction during the year and $4,000,000 on maintenance. Only $15,000,000 will be available for road work next year.

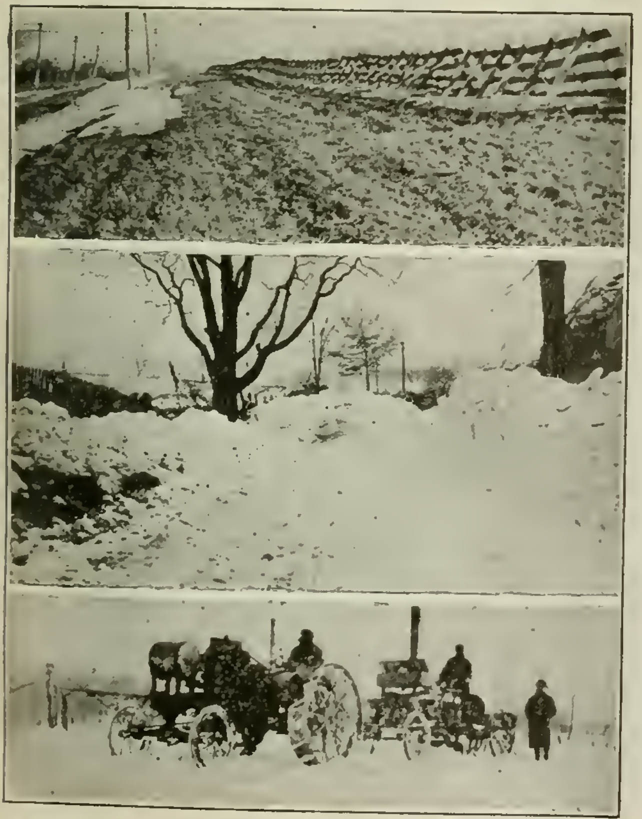
Snow Removal In Pennsylvania

About 11,000 miles of primary roads to be kept free of snow during the coming winter by the State Highway Department. Snow removal on these roads last winter cost about $113,000.

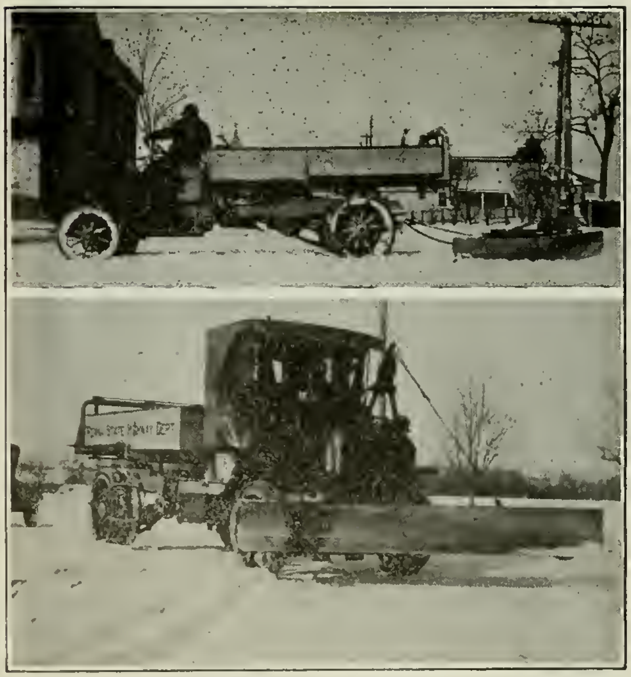
Previous to the regulation of highway traffic to secure increased efficiency under the conditions developed during the war, no considerable effort had been made to maintain any large proportions of the Pennsylvania highway free from obstruction by snow.

The state of Pennsylvania has about 100,000 miles of highways in level, hilly and mountainous country serving agricultural, mining, commercial and many manufacturing districts, including several large cities and a great number of smaller cities, towns and villages. Within a few years the state legislature has declared about 11,000 miles of these roads to be state roads, constructed, reconstructed and maintained by the State Highway Commission and forming a system which provides several north and south and east and west cross routes and interstate routes forming trunk lines for through freight and for the connection of the principal traffic centers of this state.

During the war the United States government inaugurated and developed the system of motor truck transportation of military supplies from the manufacturers to the seaboard by routes that traversed some of the most important highways in the state. While this traffic was maintained a system was worked out by the highway department in co-operation with the weather bureau and federal military officials, under which the highway department received daily reports from the weather bureau at Washington, which, in conjunction with other data available in the federal offices, permitted the development of a system by which it is now possible for the district engineers in the highway department to anticipate any meteorological requirements and to be prepared to cope with the probable snowfall by providing in advance sufficient horses and equipment to commence its removal as soon as the storm begins and to continue it day and night if necessary until the storm ends and the routes are satisfactorily cleared, which is accomplished with the regular machinery owned by the department and by an abundance of hand labor and teams that are thus maintained in readiness. The great importance of this work is indicated by the expenditure for it of $69,000 in 1918, $10,000 in 1919 (when the snowfall was very light and the weather mild), and $113,000 in 1920.



WINDBREAK TO PROTECT HIGHWAY FROM SNOW DRIFTS
HEAVY SNOWFALL ON STATE ROAD
HANDLING ROAD MACHINE WITH TRACTOR TO CLEAR SNOW



HAULING V-SHAPE WOODEN SCRAPER WITH TRUCK
TRUCK PUSHING REGULAR STEEL SCRAPER

In general, as soon as the snow begins to fall its removal is vigorously commenced with snowplows operated by automobile trucks and by road machines and drags, generally pulled by trucks, but sometimes hauled by teams. Each day the numerous superintendents throughout the state receive reports from the United States weather bureau, which give the weather probabilities for each route and section. Each day the superintendents mail to the maintenance division in the head office of the State Highway Commission at Harrisburg a statement for each route and section, giving weather conditions (under headings of clear, cloudy, rain, snow, depth of snow), and road conditions (under headings of good, fair, poor, slippery or impassable). These are all posted on 16 x 11-inch loose leaf printed blanks having 35 horizontal record lines and headings with vertical rulings for county, route, section, location, weather conditions and road conditions and remarks. These data are transmitted to the extension bureau that furnishes valuable information based on them to the local newspapers.

Ordinarily the snow is first cleared for a width of 8 feet from end to end of the road, thus providing a single track with wider spaces for turnouts at intervals. The work is carried on day and night as long as the storm lasts, and afterwards until the required width is fully cleared, which is frequently simultaneous with the cessation of the snowfall.

The department has 41 plows manufactured by the Good Roads Machinery Co., each of which is provided with two automobile trucks, generally Nash Quads (4-wheel drive), one of them being used as an emergency reserve or to push in case of very heavy work being required. There are also available V-shaped plows drawn by horses or tractors, 288 road machines, mostly Champions, and 110 tractors. This equipment is generally distributed throughout the state and is available at points accessible for immediate use on the roads in the localities where it is required.

Record September Construction

Building contracts awarded during September in the 27 northeastern states are estimated in the F. W. Dodge Company's review to amount to $246,186,000, the largest monthly total of this year and the largest September figure on record. This is an increase of 11½ per cent over the August figure, which itself is ordinarily 14½ per cent less than the average September figure.

The greatest increase was in the New York district and the most significant feature was the increased volume of business building that represented 17 per cent of the total. Public works and utilities were 14 per cent of the total.

The San Antonio Flood

Unusual precipitation on saturated ground and river channel obstructed by bridge piling caused flooding of business section fifteen feet deep. Large areas of wood block pavement floated away.

San Antonio, Texas, has joined the list of those cities which, not having taken with sufficient seriousness previous warnings in the form of minor floods in the streams passing through them, have suffered disaster by an unusual flood. During the night of September 9 and 10 this city was visited by a flood which caused more than 50 deaths and covered the streets of a large part of the business section to depths up to 15 feet or more.

In 1914 there was a heavy flood which caused so much damage and inconvenience that steps were taken toward flood prevention and the engineering firm of Metcalf & Eddy, of Boston, made recommendations to this end. Some steps had been taken toward following out these recommendations but not much actual work had been done. Now, however, it is probable that active steps will be taken at once to prevent a recurrence of this year's disastrous flood.

The San Antonio river winds with a very circuitous course through the city, crossing numerous streets and spanned by 25 bridges within the city limits. Many of these bridges consisted of short wooden spans supported on piles and the presence of these undoubtedly added considerably to the volume of the flood, since large amounts of debris were held back by these pile bents with their comparatively narrow openings and these piled up the flood waters and caused them to overflow into the adjoining streets.

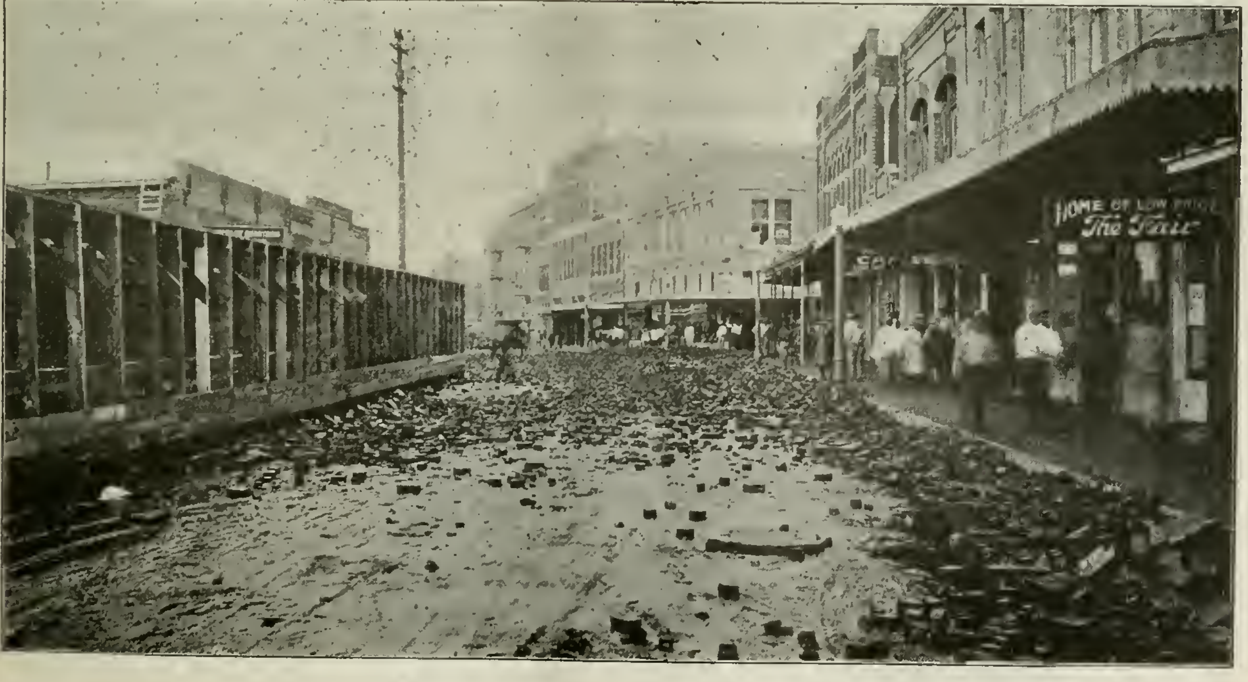
Just above the city the river is joined by a creek known as Olmos creek, while just below the city there enters the river a stream formed by the junction of the Alazan, the Martines, the Zarzamora and the San Pedro creeks, which all join a short distance from the discharge into the San Antonio river. Reports indicate that the height of the flood was due to floods coming from these several creeks into the river at just the successive periods necessary to produce maximum flood conditions, although the waters from the Olmos watershed appear to have been chiefly responsible. The floods on the several creeks were due to unusually heavy rainfalls following a storm which had already soaked the ground. Up to Friday night approximately 7.5 inches of rain had fallen in the city and the river was about 3 feet above its normal stage. Shortly after 8 o'clock that evening there was a heavy rainfall on the Olmos creek watershed estimated at 13 inches falling within two hours. This was the chief cause of the flood. By 11:30 the river was beginning to overflow its banks and by 2:45 in the morning of the 10th it had reached a height of 14 or 15 feet in some places. It then receded rapidly and by 7 o'clock all but a few of the lowest streets were above water.

The cleaning up of the flooded district was undertaken with energy, the army loaning the city a number of trucks to be used for this purpose, all of the city trucks ordinarily used for ash and garbage collection and otherwise being in use at the same time. By the end of a week this work was practically completed and the regular collection of ashes and garbage was resumed. The soldiers of the 8th Corps, located at Fort Sam Houston, aided greatly in the work of restoring physical conditions as well as in maintaining order and preventing looting, and assistance was of course rendered by contractors and all others having men or vehicles available. Although the citizens had suffered considerable loss because of the flood, outside help was declined and the city made an appropriation for reconstructing streets and also for carrying out the plans for prevention of a recurrence of the disaster.

One feature which is peculiar to this flood was the destruction of the streets, which demanded the immediate expenditure of a quarter of a million dollars for restoring traffic even after the flood debris had been removed. A considerable part of the paving in the business district had been wood blocks. A local paper issued the day before the flood stated that many of the wood block streets were bulging in spots because of the swelling of the blocks following the heavy rain of the several days previous, and the city engineer proposed to give these blocks a heavy dose of oil as soon as they dried out. The flood water, however, got under the blocks and a large percentage of them were lifted from the base and washed away, some of them to farms below the city, but most of them were carried comparatively short distances. A great many of them were washed into the sewers, some of them into house sewers as well as the storm sewers, and considerable trouble was experienced in remedying the stoppages caused thereby.

QUEEN ANNE COURT, SHOWING ROCK ASPHALT PAVEMENT TORN UP BY LIGHTNING

This condition made it necessary to begin immediately the reconstruction of the pavements. Out of a total of 155,000 square yards of creosoted wood block pavement, the city engineer reported that 57,665 square yards had been absolutely washed away. A small part of this total area consisted of small patches which could be relaid, using blocks which were salvaged from various points; but it was decided to relay at once 45,850 square yards with some material other than wood block, bituminous surfaces being selected. City Engineer D. D. Harrigan planned to let contracts for this paving at once and have three shifts of men working day and night, which would permit completion of the work in 30 days, he thought. The plan was to utilize the concrete base of the old wood block pavement and on this lay a 2½-inch bituminous concrete base and on this a 2-inch bituminous wearing surface. On September 22, contracts were made with the Southwestern



WEST COMMERCE STREET ON THE MORNING AFTER THE FLOOD
Water had covered street two feet deep. Wood blocks seen in background washed up into high pile, and scattered over the street

Bitulithic Co. for 31,400 square yards of the new pavement and with the Uvaldè Co. tor 14,450 square yards. The Bitulithic company agreed to lay a 2-inch Warrenite-bitulithic surface on a 2½-inch bituminous concrete base at $2.50 per square yard, which was $.55 below the price formerly charged. The Uvalde Co. contracted for $2.55 a square yard, which was its former price. Arrangements were made with the property owners for paying two-thirds of the cost of the new pavement, estimated at $250,000. A considerable amount will be borne by the San Antonio Public Service Corporation, while the balance, estimated at about $60,000, will be paid by the city.

Aside from the destruction of the wood block pavements, little damage was done to the streets. One brick street was slightly damaged but none of the bituminous pavements were disturbed. Some of these bituminous pavements were on macadam base and some on concrete. One of the latter was under ten feet of water and the force of the flood swept away the concrete railings of a bridge close by and carried one house into the middle of the street, but did no damage to the pavement.

It is not the purpose of a wood block pavement to withstand a flood, and the fact that these blocks were floated away is no disparagement of them as a pavement wearing surface; but there are some cities or sections of cities which are subject to occasional floods, and this is by no means the first time that wood block pavements have been removed from flooded streets. So far as we recall, however, this is the most extensive removal of creosoted wood block by floods that has come to our notice. In view of this possibility, it would seem to be a wise precaution to avoid the use of such blocks as paving material at any points liable to flooding.

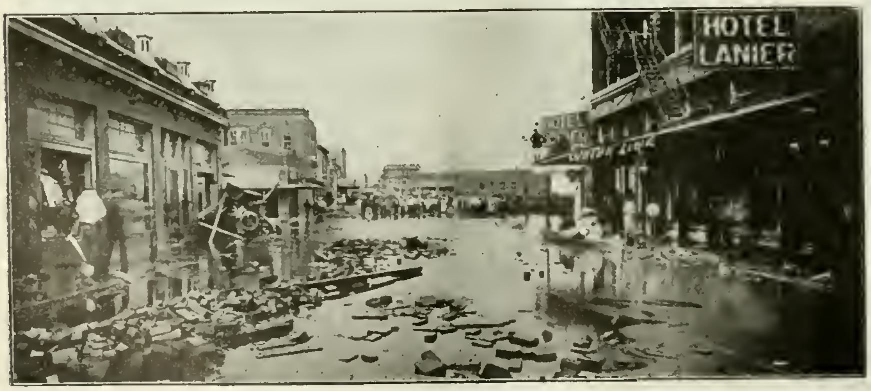
Attention is also called to the important part played by obstructions in the river occasioned by the pile supports of several of the bridges. Had not twelve of these bridges been washed away the flood would probably have risen higher and lasted longer. Most floods in every stream bring down large quantities of floating debris, such as trees, lumber, small buildings and the like, and anything which holds back these materials and allows them to pile up, especially in a shallow stream, is sure to add to the damage done by the flood by causing it to back up and find its way around the ends of the bridge, through the adjacent streets of the city. Piers or other stream obstructions should be eliminated or reduced to the least possible number, and those necessarily present should be designed to offer the least possible obstruction to water and floating debris.

For the details given above and the illustrations we are indebted to F. E. Rightor, M. Am. Soc., C. E., president of the Southwest Bitulithic Co.

Progress of Federal Aid Work

The month of June, which is the latest for which official figures are yet obtainable, was a record month in the construction of federal aid highways. Projects previously under way were completed during that month that had a total length of more than 1,200 miles—more than twice the amount completed during the month of May. During the fiscal year ending June 30 the total of completed projects had increased from 1,677 miles to 7,469, while projects under construction had increased from 14,940 to 17,977. The total amount of federal aid to which the states had become entitled through completion of work had increased from $40,097,881 to $118,915,515. The amount o increase during the year was nearly twice as much as during the four preceding years combined. These figures refer to projects completed, and not to amounts of work done, the former being used by the Bureau of Public Roads as the basis for its records.

In addition to the larger sum mentioned above, $66,375,636 has been allotted to the several states but not yet earned by the completion of the projects. There also remains $18,793,544 not obligated on June 1. Of the more than $66,000,000 allotted but not yet paid out, not all is available for future work, a large part of it having really been earned by the states but not yet received because the projects for which they are to be paid have not been completed. For instance, New York state was allotted $13,420,508 but on June 30 had completed projects calling for only $133,673, apparently leaving over $13,000,000 still to be earned. A considerable part of this, however, is to be applied to projects which have been under construction for some time and some of which may have been completed since June 30. However, in this as in many other states there is yet a large amount of uncompleted work and the unemployment emergency will probably lead to a speeding up of this and a continuation of it through the winter so far as possible.



TRAVIS STREET AFTER FLOOD HAD SUBSIDED
High water reached the awnings at the right, indicated by the words "Water line."

Handling Liquid Chlorine

By D. K. Bartlett[†]

Explanation of its characteristics and the precautions that should be taken in handling and storing it.

Chlorine in liquid form has now been used in this country since 1907. In common with all other compressed gases there are very definite and careful regulations drawn by the I. C. C. governing its transportation. Under these regulations there are four accepted containers in which the material may be moved, namely, those which cary 100 lbs., 150 lbs., 2000 lbs., and 30,000 lbs. As there have been no accidents in Interstate Commerce since the regulations have been in force it would seem proper to assume that the regulations are right, as they now stand.

The use of chlorine has become very widespread through the textile industry, the public water supply system, the flour industry, the chemical industry, and the pulp and paper industry. Liquid chlorine is today stored in from 4,000 to 5,000 different points in quantities of from a few cylinders to many thousand pounds. So far such regulations covering storage as have been in force are simply those recommended by the producer to the consumer. Safety is of prime importance to the producer as well as the consumer, and while the hazard is much less than is commonly supposed, it is, nevertheless, sufficient to cause the producers to adhere to and recommend regulations which make the use of this material safe.

It may be well at this point to consider briefly the hazards of compressed gases in general.

As long as the gas remains in the container, it is obvious that it can do no harm, irrespective of its effect when released. It is therefore necessary to consider the probability of escape of gas from the container, as well as the qualities of the gas itself. An escape of gas from a container may be due to—

A. A true explosion.

B. An increase of pressure, due to heat, sufficient to rupture the container.

C. Leaks.

If the gas escapes from the container, the resulting hazard may be due to—

1. Inflammability.
2. Poisonous effects.
3. Irritating effects, with interference with sight or respiration.

Considering now the specific case of chlorine, we can eliminate "A" since it is non-explosive. The chance of a rupture due to "B" is very slight on account of the high critical temperature of chlorine. The following table gives this temperature for a number of common gases:

Chlorine	146
Ammonia	132
Acetylene	36.5
Nitrous Oxide	36.5
Carbon Dioxide	31
Oxygen	-118
Hydrogen	-240

By I. C. C. regulations all cylinders and ton drums are provided with fusible plugs which melt at 158 deg. Fahrenheit, at which temperature the pressure is about half the test pressure of ton drums at time of manufacture and a quarter of the test pressure of the smaller cylinders.

There has never been an instance of bursting of a container in transit, or in a user's plant.

There have been four or five cases of the rupture of containers in the manufacturer's plant due to the presence of foreign material in the container which reacted with the chlorine. To guard against repetition of such accidents, all manufacturers now have in force a rigid system of inspection of empty containers. Even should a container with such foreign material be filled, any trouble resulting will necessarily develop within a few hours, so that any hazard existing from this cause concerns only the manufacturer—not the user or the carrier.

There have also been a few cases of fire where a large quantity of chlorine has been stored. In each case the upward draft due to the heat of conflagration has been strong enough to carry the gas upward and cause a sufficient dilution so that the fire fighters were caused no inconvenience in their work.

This brings us to leaks. Here the evil smell of chlorine is its own greatest safety factor. Its presence in the atmosphere can be detected in very minute quantities through the sense of smell. After the person in charge of the use of the chlorine in any plant has had his first considerable whiff, he is quite ready—from then on—to exercise reasonable care, take necessary precautions, and follow the instructions laid down by the manufacturer.

The next safety factor is the slow absorption of the heat necessary to evaporate the liquid into a gas. The following table gives the rise of temperature of the liquid chlorine in a tank car during a period of 96 hours:

Time	*Temp. Contents*	*Change during period*	*Pressure*	*Change during Period*
(Start)	(—9 deg. C.)	—	(64 lbs.)	—
End 24 hrs.	—2 deg. C.	7 deg. C.	76 lbs.	12 lbs.
End 48 hrs.	+3.5 deg. C.	5.5 deg. C.	88 lbs.	12 lbs.
End 74 hrs.	+6 deg. C.	2.5 deg. C.	93 lbs.	5 lbs.
End 96 hrs.	+8.5 deg. C.	2.5 deg. C.	98 lbs.	5 lbs.

When the odor of chlorine is noticed the source should immediately be located. Never hunt a leak through the sense of smell. Always have a gas mask handy and be sure you have fresh canisters. The mask is not apt to be used, but it gives confidence to the one hunting the leak. Have a bottle of aqua ammonia and a piece of waste fastened to the end of a short stick. Dip the

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Paper read before National Safety Council Congress.

[†] Vice-president Electro Bleaching Gas Co.

waste into the ammonia and start your search. The moment you come to chlorine in the air, a white fume of ammonium chloride will appear. As you reach a denser volume of chlorine, the white fumes are denser. Thus the leak is quickly located. If this leak is in the piping, etc., shut off the valves at the containers and repair. If in a valve on the container or the container itself, and it cannot be stopped, connect the gas valve from the container to your absorption system and begin to operate. The liquid cannot evaporate in the containers, without the application of heat, as fast as the gas is absorbed in your system, and thus the leak quickly stops.

As to the properties of chlorine, it is non-inflammable, and not poisonous, in the sense that carbon monoxide or phosgene for instance is poisonous. We can therefore eliminate Nos. 1 and 2, and confine ourselves to No. 3.

The immediate result of inhaling a large quantity of chlorine gas is the inflammation of the tissues lining the throat with resulting coughing and nausea. While it is highly irritating and extremely uncomfortable, it is never fatal—unless the subject remains for a considerable period in an atmosphere of highly concentrated gas.

Should a person be affected by chlorine gas we recommend the following treatment: Remove at once to the open air and away from all gas fumes. Place the patient flat on his back with head slightly elevated, and give a half teaspoonful of essence of peppermint, or a moderate dose of bromo seltzer or whiskey. This will relieve the tendency to cough and soothe the inflamed membranes, allowing the passage of air and promoting the action of the respiratory organs. The person affected should himself resist as much as possible the impulse to cough. A mustard plaster on the chest will give prompt relief. While there are never any serious after-effects, a physician should always be called.

As this discussion is before the Pulp and Paper Section, we can safely assume that we are preparing to store a considerable quantity of chlorine. First let us discuss storage in either cylinders or ton drums.

The storage space should be selected with an eye to easy unloading and transfer to the aborption room. Either of the smaller cylinders may be readily unloaded from a car and rolled over a floor by one man, but if possible, overhead trolleys should be installed for carrying them. They are suspended from the trolley by a chain block and grasped by a pair of tongs made especially for this purpose. Cylinders are usually handled and stored in an upright position. Ton drums are shipped in gondola cars, each drum resting in a cradle. In unloading them it is therefore necessary to lift the drum clear of the car by means of a chain block and crane or similar device, after which it may be conveyed to the absorption room by either rolling over a level floor or track, or carried by an overhead trolley or industrial car. Ton drums are always used and stored in a horizontal position. The storage had best be under a roof but without sides on a concrete floor above any possible flood line. It would hardly seem necessary to enclose the storage space to protect against unauthorized handling of the cylinders.

The large user will wish to receive this material in the 30,000-lb. container, which is permanently fastened to a standard freight car and thus becomes a tank car, and so freight is paid only on the contents. This means a very large saving in the delivered cost of the bleaching material. Thus far the major portion of the material moved in tank cars has been delivered from the car directly into the absorption system, the cars in many cases being emptied in from four to six days. Here again is a marked reduction in cost due to elimination of handling charges.

Mills using liquid chlorine, who can take tank car deliveries, should face the storage problem. There are two methods open. First, the filling of the 2,000-lb. container or the so-called ton drum, or fixed tanks large enough to take one tank car only. Both methods are now being installed for the purpose of getting comparative data.

In our opinion, the local conditions affect this problem so that a detailed discussion of the best method of storage is useless—at least at the present state of the art. The problem is, however, one which can readily be worked out for any particular case.

Highway Work In Minnesota

The state highway commissioner of Minnesota, Charles M. Babcock, has recently issued a statement concerning the possibility of giving employment to labor on the highways during the winter. He estimated that more than 10,000 men and hundreds of teams could earn upwards of $7,500,000 in wages on Minnesota highways this winter. He finds that labor this year has been receiving more than 65 per cent of the amount paid to contractors and that winter work will give labor a still higher percentage because of the relatively larger amount of graveling and distribution of materials that would be done. About 10,150 men were employed this season on the trunk routes, of which 6,300 were still at work at the end of September, but practically all of them would lose their jobs about November 1 unless arrangement is made for continuing the work throughout the winter.

During this season there has been spent on the trunk highways $4,758,026 for grading, $1,605,122 for gravel surfacing and about $6,500,000 for other work.

Six hundred and eighty miles of grading this year bring the total miles of trunk routes graded to 2,179; 215 miles have been paved, 103 of them during the present season and 428 miles of graveling this season bring the total gravel surface to 1,809. In addition, the maintenance department this season regraveled 462 miles and reshaped 713 miles. The program for the season is more than two-thirds finished.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

Building Bridge Piers on Rock in Shallow Water

Short span bridges often need to have their concrete abutments or intermediate piers carried down to footings on rock bottom in shallow water or under a few feet of earth close to the river, where the ground is saturated and water flows freely below the river level.

In such cases the contractor is sometimes unduly discouraged because he is not familiar with work below water level and ordinary excavation and sheeting will not keep the site of the pier dry. If the bottom is very irregular or the current swift, the work may prove difficult and expensive, but under ordinary conditions of still water not more than 3 or 4 feet deep and having a smooth regular bottom, the footings can generally be put in satisfactorily without excessive costs or delay.

EARTH COFFERDAMS

If the contractor has work on the same job or near by involving drainage or other excavation that produces waste spoil, almost any kind of material excepting large stones and boulders can be used to form the cofferdam enclosing the footings.

In rare cases where local conditions and topography are favorable it may be possible to make a cut off, or by-pass the water around the site by building dams across the channel above and below the bridge location and turning the flow of the stream through a new channel cut for this purpose or through a pipe or flume discharging into the old bed below the lower dam.

If there is a falls or rapids in the river just below the bridge site it may obviate the necessity for the lower dam and might even provide sufficient head to make it possible to syphon a very small flow through a pipe laid on the surface of the ground and thus greatly reduce the cost of the by-pass if the pipe, which may be of very light construction, is conveniently available from stock or from local sources or can be temporarily borrowed from permanent construction.

Operations should be arranged if possible to be carried on at the time of minimum stream flow when the bed of the river may be naturally almost dry and the trickle of water, that would then accumulate considerable volume if backed up by the dam, may be carried in an ordinary water pipe.

Almost any earth, rock or gravel may be used to give stability to the cofferdam, but unless it contains a suitable amount of fine compactible material it will not be watertight, but it may be placed on the upstream side with a comparatively thin layer of small stones and gravel, filling the interstices of coarser stone and covered in turn with mixed sand and fine gravel, sand, earth or preferably clay, which will generally make the dam reasonably tight.

If there are leaks under the dam or through the fissues in the rock bottom that produce a considerable flow into the enclosed space, it may be possible to excavate a rough channel to carry it to a sump, where a steam or gasoline pump can be installed that will handle a considerable volume of water cheaply.

STOP LEAKS AND PUMPING

Careful examination may disclose the location of the most important leaks, and sand, clay and even hay, straw or manure may be forced into them and sometimes be successful in closing them. It may also be possible to cover the particularly bad portions of the bottom with canvas held down by a mass of earth or clay dumped over it.

For very shallow water with a smooth, flat bottom a dam can often be made with empty cement bags, three-fourths filled with sand and piled up carefully to form an enclosing wall. This will stop the free flow of the water and will conform closely to the surface of the bottom and when reinforced by clay on the outer face may make a sufficiently tight dam, easily built and shifted, that does not occupy so much space or require so much material as a dam of loose earth.

If the current is swift enough to scour away an earth dam, boxes or cribs of convenient size made of any available timber, or boards, no matter how poor, that will hold together can be arranged close together enclosing the pier, balasted with stone, sunk to position and filled with earth and clay and more earth and clay if necessary dumped around the outside.

If serious leaks occur all over the enclosed area, the latter may be subdivided into one or more smaller areas by successive dams or partitions built across the main cofferdam, leaving small portions of space in which the leakage is much diminished and may be pumped out, one at a time, and the footing placed in them, sealing the leaking bottom and providing a base to which the watertight forms can be attached successively, eventually extending over the full area of the completed foundation.

ENCLOSING AND VENTING LEAKS

If large definite leaks are discovered inside the cofferdam and cannot be stopped, a dam can sometimes be built around them, enclosing them and enabling the rest of the area to be unwatered and the footing laid, enclosing the leaks in the well, which can, if necessary, be eventually closed under pressure. For small leaks vertical steel vent pipes may be inserted in the hole in the bottom of the river, preventing the accumulation of water pressure and being held in position by concrete deposited around and protecting them until it has set and has sufficient strength and weight to resist the upward pressure. The footing may then be completed with the vent pipe passing through it and eventually the latter can be filled or closed under pressure and cut off flush with the top of the concrete, thus remaining permanently in position without injury to the structure.

SUBMERGED FORMS

The forms for the piers may be made with watertight panels of heavy boards bolted together through outside vertical corner posts. The lower edges of the vertical walls may be cut to conform as closely as possible with the rock surface. The complete form, a little higher than the depth of the water, should be built on land, assembled complete, floated or derricked to position, centered and sunk with ballast and the bottom sealed or partly sealed with clay dumped around the outside or with a canvas apron attached to the lower edge, extending over the surface of the rock and covered with clay or earth.

CONCRETING UNDER WATER

If this does not permit the water to be entirely pumped out, it will probably enable it to be brought down considerably below the level of the water outside, reducing the depth so much that the men can work in it to clean and dress the rock surface if necessary, and to place concrete.

It must be remembered that good concrete properly handled may be placed in the water without injury so that a few inches of water in the bottom of the form is not a serious matter if the work is promptly and correctly handled.

Concrete should never be deposited loose in flowing water, but may be carefully dumped in shallow still water. It is better, however, to deposit it carefully with a bottom dumping bucket or through a trough or tube resting on the bottom that protects it from the water until it is in position. Concrete in heavy paper or burlap bags may be lowered to the bottom of shallow slowly running water and the bags opened by hand after they have reached the bottom and they are then withdrawn, leaving the concrete deposited in position.

SEALING THE BOTTOM

If the piers are large and the bottom is satisfactory in its natural condition or can be made so by scraping, dragging, etc., under water, the pier may be built with a permanent or detachable form carefully secured in position without any attempt at first to remove the water from the interior.

The form, which can be built on the shore, should be made watertight with gaskets, packing or caulking, and after it is in position concrete, to a depth of a foot or more, should be deposited under water covering the entire bottom, and when it is set forming a shield to exclude the water from the leaks under the edges and through the rock bottom. The depth of this concrete must be calculated great enough so that the mass of concrete will be heavy enough to resist the upward pressure at the bottom, else it may be floated up and broken when the form or cofferdam is pumped out above it. A thickness of concrete a little more than one-third of the distance from the top to the waterlevel outside will suffice for this purpose, and after it has set the form may be pumped out and the remainder of the concrete placed in the dry provided the form has been made strong enough and is sufficiently well braced by the interior pieces to resist the outer pressure, which will be heavy in proportion to the depth of the water.

TREMIE CONCRETING

If satisfactory provision is made for depositing the concrete under water it will be unnecessary to make a form watertight or brace it heavily, and all of the submerged concrete may be placed by means of a bottom-dump bucket or a Tremie. This consists of a moveable steel or wooden tube not less than six inches in diameter, terminating at the top in a hopper. Provision must be made for steadily moving it longitudinally and transversely so as cover the entire area, and to raise and lower it by a tackle, derrick, or some other convenient method.

The bottom should be temporarily enclosed by an easily removable board or some other device, the tube filled with concrete and lowered until it rests on the bottom. When all is in readiness the bottom of the tube should be opened and the tube raised a few inches allowing the concrete to flow out of the bottom, where it will soon form a heap, sealing the tube so that the flow will cease if the tube remains stationary. Provision must be made to supply fresh concrete to the hopper continually and the tube should be slowly moved back and forth across the form and from end to end, great care being taken to always have it filled and the hopper half filled with concrete to insure a steady continuous flow that prevents water from entering the tube and washing the concrete away. If this is carefully done, the concrete deposited under water should be as good as that laid in the open air. The work of the tremie must be carried on continuously day and night until the full mass of concrete is carried up above water level. If at any time it ceases, the tremie should be immediately withdrawn and the bottom closed, concrete filled in and the original operations resumed, otherwise there is likely to be a poor batch of concrete deposited when the first part of it is dumped into the tube full of water. For tremie work the concrete should be thoroughly mixed and should be rich and as dry as possible. If submerged concrete is allowed to stand a few hours the top will become covered with "laitance," a thick slimy substance that must be scraped or washed away before more concrete is deposited, else it will make a bad weak place and prevent the set and bonding of the concrete placed against it.

Per Capita Use of Electricity, Gas and Water

General averages of such use classified by size of city and geographical location, with maximums to be provided for in capacity of plant.

We desire to obtain statistics upon the K. W. hrs., the gallons of water, the gallons of sewage, the cubic feet of illuminating gas, used by 1000 inhabitants and to obtain data regarding the load characteristics. I am asking if you know of any municipalities, engineering schools, associations or publications that have considered these problems. Any reference or data that you can send us will be greatly appreciated.

In answering the above question, we called attention to the abundance of figures available in reports of cities, commissions and committees of technical societies, which we endeavored to summarize as follows:

ELECTRIC CONSUMPTION

Taking up first the matter of electricity, the total amount consumed per capita per year for light, grouping all of the cities of the country in accordance with their population, varied from 44 k. w. h. for communities of under 1,000 to 105 k. w. h. for communities of 500,000 and over. In a general way the per capita use of electricity increases with the size of the community. Current used for power varied from an average of 95 k. w. h. for communities of between 2,000 and 5,000 to 269 for communities of between 50,000 and 100,000; the amount of power consumed not varying directly as the population, and averaging 200 k. w. h. per capita for the entire country. The above figures are those given by the Bureau of the Census and applied to the year 1917, the latest yet given out by the Census Bureau.

Analyzing the same figures by states instead of by population groups, we find the consumption for light varying from 37 per capita in Virginia to a maximum of 152 in California; the average for the entire country being 81. The consumption for power varied from a minimum of 24 in Arkansas to a maximum of 3,522 per capita in Montana.

It is seen from the above that the amount of current consumed varies largely with the size and geographical location of the community in question. Two hundred and fifty-four stations in Minnesota in 1917 showed an average per capita consumption of 102 k. w. h. for light and 181 for power. In each case the figures given are based upon the population actually served with electric current and not upon the total population of the state.

As to the capacity of the plant, we find that the kilowatt capacity of the dynamos operated averages about one kilowatt for each 2,500 k. w. h. sold during the year. This varies quite widely, however, from 2,000 or a little under to more than 5,000, the ratio in Montana being about 5,300 k. w. h. per kilowatt capacity, this being the average of 60 stations. The excess capacity is, of course, to provide for peak loads, stand-by apparatus and increase in business.

Probably the most detailed information to be found concerning both electricity and gas consumed and manufactured is that collected by the Board of Gas and Electric Light Commissioners of Massachusetts and published annually. From their report for the year 1919, the latest yet available, we quote a few figures, one concerning the largest plant, the Edison in Boston and the other concerning one of the smallest, that at Charlemont. The Edison company had 96,885 customers using incandescent lights only, 272 using both arc and incandescent, 1,239 using power only and 13,163 using both light and power, a total of 111,569. The total lighting load was 152,007 kw. and the total power load was 226,325, a total of 379,332. In Charlemont there were 41 customers, the total lighting load was 30.5 kw. and there was no power load. The variations between these two is considerable, the total load being about 3.4 kw. per customer in the Edison Boston plant and about 0.74 kw. in Charlemont. The maximum station load in the large plant was 95,774, falling to 25,000 on the day of least output. No records of this kind are available for the Charlemont plant. In general, however, the maximum varies from 1-½ to 3 times that of the day of least output.

GAS CONSUMPTION

Taking up next the matter of gas, we find that in all the Massachusetts cities averaged together the consumption of gas during the year averaged 20,335 feet per consumer, varying from a minimum of 5,820 in Oak Bluffs with a population of 1,245 to a maximum of 36,474 in Newton with a population of 43,114 although Boston was not far behind with an average of 32,325. In the small town of Oak Bluffs the amount of gas sold by meter during the year was 1,164,000 while none was sold for public lamps. In Boston the amount sold by meter was 5,794,772,301, while 123,203,871 was sold for lamps. In Boston 3.37% was unaccounted for, while in Oak Bluffs 25.57% of the gas was unaccounted for. The daily capacity of the works in Boston was 42,300,000 feet and the greatest daily output was 22,639,000 and the least output 10,602,000. In Oak Bluffs the capacity of the works was 150,000, the greatest output was 28,000 and the least output 11,000.

WATER CONSUMPTION

In the matter of water the figures vary nearly as widely, running from a minimum of about 30 gallons per capita to a maximum of more than 200. With leakage from mains and waste by consumers reduced to a minimum, and estimating the consumption on the number of consumers rather than on the total population, the great majority of places will not require more than from 40 to 70 gallons per capita; except that where there is a relatively large amount of water used by manufacturing and other industries, the consumption may be increased by as much as 100 gallons per capita for these purposes alone.

The consumption of water varies somewhat with the seasons, but not quite so much as that of electricity and gas when used for lighting. The maximum daily consumption of water will ordinarily run about 50 per cent above the yearly average, although it may reach 100 per cent. The hourly maximum will probably reach 200 and possibly 250 per cent of the average for the year. The distribution system, of course, should provide for the maximum hourly rate, but the pumping station, if there is one, need not provide for this if there are reservoirs of sufficient capacity. The plant, however, should, as in the case of an electric light plant, have reserve units to be put into service in case of a breakdown and should have ample provision for growth in consumption for several years in the future.

AMOUNT OF SEWAGE

The amount of sewage from buildings is ordinarily assumed to be the same as the amount of water entering the same buildings. However, some water used for sprinkling lawns, etc., does not reach the sewers, and on the other hand some manufacturing plants having their own water supply may discharge this into the sewer. The amount of each of these must be judged from local conditions.

These various subjects will be found discussed at length in text books dealing with these matters, in papers before the different electric, water works and engineering societies, in technical papers, in reports of municipal plants, etc.

National Contractors Drive for Construction

Meetings of representative citizens and general contractors have been arranged in the principal cities of the country to discuss ways and means of getting public construction under way. W. O. Winston of Minneapolis, president of the Associated General Contractors of America, W. A. Rogers of Chicago, F. L. Cranford and D. A. Garber of New York, together with G. W. Buchholz, secretary, and E. J. Harding, assistant secretary of the Associated General Contractors of America, will address the meetings in behalf of an aggresive program, both national and local, to start construction.

That this construction program cannot be gotten under way without the organized effort of community and construction interests, will be the message carried by these leaders. While the construction of homes, schools, buildings, highways, streets, railroads, public works and repairs of all kinds, reclamation projects and hydro-electric development, as urged by the National Conference on Unemployment, will undoubtedly directly set to work a million men who will in turn give work to millions more, there is needed first a thorough-going analysis of present construction costs in every city, including costs of finance, insurance and bonds, materials, labor, transportation and management. Moreover, there must be adequate provision for settling questions in dispute without the great loss of time caused by strikes and lockouts; and there must be sincere co-operation between organizations representing every element of the construction industry.

To start this work, central committees of general contractors in each of the cities will be appointed as nuclei of a permanent organization. The work now being done by similar organizations affiliated with the Associated General Contractors of America in other cities will be outlined, as illustrative of what might be accomplished. Under the direction of General R. C. Marshall, Jr., formerly chief of the construction division of the War Department and chairman of the construction committee of the President's Unemployment Conference, this work has already been organized in from twenty-five to thirty cities, covering in some instances entire states. From headquarters in Washington, General Marshall, as general manager of the Associated General Contractors of America, is already working through national committees of general contractors on labor, materials, methods, contracts, insurance and bonds, transportation, codes, legislation, information and statistics to bring about conditions which will make possible the carrying out of the construction program outlined by the President's Conference.

The organization of local conference boards representing architects, engineers, contractors and labor to handle local jurisdictional disputes and other local construction problems will be recommended. Local committees will be urged to secure the fall letting of public work and highway contracts. Other committees to secure adequate legislation for highway and water-power development will be recommended. Investigations in better methods of accounting and estimating and improved contract forms will be suggested. Close co-operation with national headquarters in the entire campaign will be assured through monthly, weekly and special bulletins and reports.

Recent Legal Decisions

ACQUISITION OF WATER SYSTEM BY MUNICIPALITY—TIME OF VALUATION

The California Railroad Commission, in fixing the amount of just compensation to be paid by the city of Auburn for the water system, owned by Pacific Gas & Electric Company, supplying consumers in the city, holds that a valuation of the property made for condemnation purposes should be made as of the date of the filing of the original application therefor with the commission.

RATES FOR PRIVATE FIRE PROTECTION SERVICE

The Indiana Public Service Commission has frequently held that a flat rate equal to the monthly minimum charge for service connections of the same size is a reasonable rate for private fire protection service. The chief element of cost in furnishing private fire protection service is not the amount of water which flows through the connection, but the readiness to provide necessary fire pressure when required. The demand which this fire pressure will make upon the plant of the water company varies with the diameter of the required service connection.

RATES FOR PUBLIC FIRE PROTECTION SERVICE

The Maine Public Utilities Commission has several times held that the price per hydrant for fire service is not the true measure of the value of the entire service, but that the gross revenue needed and the area and value of the property protected are necessarily to be carefully considered. The amount which must ordinarily be paid for public fire protection is about 32 per cent of the gross revenue needed.

WATER COMPANY CANNOT SHUT OFF HYDRANT SERVICE FOR NONPAYMENT

The Missouri Public Service Commission holds, in proceedings by Webb City and City of Carterville to compel the Missouri Public Utilities Company to furnish fire hydrant service that, although the cities may owe the company large sums of money, the company has not the right to cut off fire hydrant service as it would the ordinary service of a private consumer, for nonpayment of bills, the cities being governmental corporations, and limited in their powers to raise money by constitutional provisions. On the other hand, when the amount of indebtedness incurred by each of them is finally determined, they cannot escape payment.

BOARD OF EDUCATION NOT COMPETENT SIGNER OF PAVING PETITION

The Kansas Supreme Court holds, Dunsworth v. City of Hutchinson, 199 Pac. 89, that, under a statute requiring a petition for the paving of a street to be signed by the resident owners of one-half the property fronting on it, the board of education, whose jurisdiction covers the city and certain attached territory, is not made a competent signer by virtue of one of its school sites abutting thereon.

CONTRACTS OF MANAGER OF MUNICIPAL LIGHTING PLANT UNDER MASSACHUSETTS STATUTE

The Circuit Court of Appeals, First Circuit, holds, Rockhill Iron & Coal Co. v. City of Taunton, 273 Fed. 96, reversing 261 Fed. 234, that under Acts of Massachusetts, 1905, c. 410, par. 3, authorizing the mayor of a city to appoint a manager of municipal lighting, who shall, under the direction and control of the mayor, have full charge of the operation and management of the plant, and of the purchase of supplies, a manager appointed for a fixed term can, in the absence of any regulations by the mayor to the contrary, make a contract for the purchase of coal required for the plant for a period extending beyond the term of the manager's appointment, which is binding upon the city after the expiration of such term.

CONTRACT FOR PURCHASE OF FIRE APPARATUS—LUMP BID INVALID WHERE SEPARATE BIDS CALLED FOR

The New Jersey Supreme Court holds, Pew v. Commissioners of Fire Dist. No. 1, 114, Atl. 151, that an award by a public body of a contract for the doing of work or the purchase of supplies, made after advertisement and competitive bidding, must be according to the terms advertised to prospective bidders, so that all may be on the same footing. An advertisement for competitive bids to furnish a fire engine called for a truck with a pumping system and body to carry 1,250 feet of hose, "each part proposed to be furnished to be separately specified by the bidder and separately priced." Applying the above rule, it is held that the contract could not be awarded on a lump bid for the entire apparatus.

VALIDITY OF A SEWER TAX BILL

In a suit to cancel and set aside a tax bill for the construction of a sewer in the city of St. Louis, the Missouri Supreme Court, St. Louis Malleable Co. v. George G. Prendergast Const. Co., 231 S. W. 989, decided the following points: The tax bill was prima facie evidence of its validity. No notice to property owners of the establishment of a taxing sewer district is necessary, as decided by the Missouri Supreme Court and the Supreme Court of the United States (Embree v. Kansas City Road Dist., 240 U. S. 242). The Missouri court has repeatedly held that the action of the municipal authorities in the establishment of a sewer district is conclusive in the absence of fraud, and not subject to review by the courts. No evidence of fraud was shown, much less any evidence connecting the contractor with fraud. A complaint of fraud comes too late after the work is completed. The municipal authorities of the city of St. Louis are the sole judges of the dimensions of contemplated sewers. Silent acquiescence with knowledge of the improvement, especially when accompanied by acceptance of its benefits, estops the property owner from denying validity of the tax bill.

NEWS OF THE SOCIETIES

Oct. 24-28 — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary. Charles Carroll Brown, St. Petersburg, Fla.

Oct. 25—ATLANTA SECTION, AMERCAN SOCIETY OF MECHANICAL ENGINEERS. Get-together dinner. Secretary, J. T. Wikle, Fulton Bag & Cotton Mills, Atlanta.

Oct. 25—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club. Secretary, W. H. Kavanaugh, University of Pennsylvania, Philadelphia.

Oct. 25—PROVIDENCE, R. I., ENGINEERING SOCIETY, MUNICIPAL SECIETY.

Oct. 26-27—OKLAHOMA SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. Oklahoma City.

Oct. 28—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Newark, N. J.

Oct. 28-29—TEXAS SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS. Dallas, Tex. Sec., E. N. Noyes, Dallas County Bank bldg., Dallas.

Oct. 28-29 — INDIANAPOLIS SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, George R. Popp, Jr., Indianapolis Water Co.

Oct. 31—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Get-together fall meeting. New York City.

Oct. 31-Nov. 5 — NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston

Nov. 1 — CLEVELAND SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Hotel Winton. Secretary, Charles H. Day, Illuminating Co.

Nov. 1—VIRGINIA SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Fall rally meeting. Secretary, Charles Loeber, R. M. Anderson Co., Richmond.

Nov. 1-4—INDUSTRIAL RELATIONS ASSOCIATIONS OF AMERICA. Waldorf-Astoria Hotel, New York City.

Nov. 2—BUFFALO SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Lafayette Hotel. Secretary, F. B. Hubbard, 146 Arkansas st.

Nov. 2—CENTRAL PENNSYLVANIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Williamsport, Pa. Secretary, Prof. F. P. Henshall, Penn. State College.

Nov. 3 — HARTFORD BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Bond Hotel. Secretary, W. D. Halsey, Hartford Steam Boiler Inspection and Insurance Co.

Nov. 4 — MINNESOTA SECTION, AMERICAN WATER WORKS ASSOCIATION. Minneapolis, Minn., Secretary, H. A. Whittaker.

Nov. 8 — WATERBURY BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce Hall. Secretary, J. R. Putnam, 61 Woodside ave.

Nov. 9—BALTIMORE SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club. Secretary, Prof. A. G. Christie, Johns Hopkins University.

Nov. 13-17—AMERICAN CIVIC ASSOCIATION. Chicago, Ill. Headquarters, 905-7 Union Trust bldg., Washington, D. C.

Nov. 14—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with A. I. E. E., A. I. M. E. and A. S. C. E.

Nov. 14—NEW HAVEN BRANCH AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Mason Laboratory, Yale University. Secretary, Prof. S. W. Dudley, 400 Temple st., New Haven.

Nov. 14 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies bldg., New York City. Sec., G. I. Rhodes, 115 Broadway, New York City.

Nov. 14-16—CITY MANAGERS' ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

Nov. 15-18—ATLANTIC DEEP WATERWAYS ASSOCIATION. Savannah, Ga. Headquarters, Real Estate Trust bldg., Philadelphia, Pa.

Nov. 16-18 — NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

Nov. 17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Society of Naval Architects and Marine Engineers. New York.

Nov. 17-18—SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS, New York.

Nov. 17 — BRIDGEPORT BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce.

Nov. 17—TOLEDO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Toledo Commerce Club. Secretary, Loring Freed, Atlas Chemical Co.

Nov. 17 — WORCESTER SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Worcester section, A. I. E. E. Secretary, Harry M. Latham, Crompton & Knowles Loom Works.

Nov. 21—CHICAGO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Western Engineering Society.

Nov. 22 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Nov. 22—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Adelphia Hotel.

Nov. 25 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel, Denver. Secretary, William Lester, Vulcan Iron Works.

Nov. 28-29—KANSAS CITY SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Two-day regional meeting. Secretary, Louis Bendit, 517 Finance bldg.

Dec. 1-3—MONTANA IRRIGATION AND DRAINAGE INSTITUTE. Great Falls, Mont.

Dec. 6-9—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 14th annual meeting. Baltimore, Md.

Dec.. 22-23—KANSAS ENGINEERING SOCIETY. Hutchinson, Kan.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

FEDERATED AMERICAN ENGINEERING SOCIETIES

The executive board of the American Engineering Council, at its meeting in Washington on September 30th, accepted the applications of the Vermont Engineers' Society and the Associated Engineers of Spokane for membership in the Federated American Engineering Societies.

MUNICIPAL ENGINEERS OF THE CITY OF NEW YORK

The Municipal Engineers of the City of New York held its monthly meeting on September 28th. Thomas H. Wiggin who has recently returned from China after two years spent in charge of engineering investigations for the improvement of the Grand Canal of China and the control of the floods of the Yellow River, addressed the society on the subject. "An Engineer's Two years in China."

AMERICAN ASSOCIATION OF PORT AUTHORITIES

The first international and tenth annual convention of the American Association of Port Autohrities opened at Seattle, Ot. 11, with the registration of 120 delegates and guests.

The convention was called to order by President Benjamin Thompson, director of the Port of Tampa, Tampa, Fla. The invocation was given by W. S. Lincoln, commissioner of the Port of Seattle.

Mayor Hugh Caldwell of Seattle delivered an address of welcome, which was responded to by President Thompson, who presented a report of the year's business of the association including his appointment of committees for investigation and reports to be made on the valuation of port properties of the Americas, dredging of waterways and harbor improvements, and insurance of terminal properties. He also reported that a European tour had been completed by a secretary of the association with the result that port authorities in many European countries had become very much interested in the work of the association.

Paper No. 13—J. Spencer Smith, vice-chairman of the Port of New York and president of the New Jersey Board of Commerce and Navigation, on "Port of New York Authority."

Paper No. 14—Capt. F. T. Chambers, Washington, on "United States Government Co-operation in Port Development."

Paper No. 15—Lt. Col. H. C. Boyden, Portland Cement Assn., on "The Practical Side of Scientific Concrete."

The following officers were elected:

President—Benjamin Thompson, director of the Port of Tampa, Tampa, Fla.

Secretary—M. P. Fennell, Jr., secretary harbor commissioners, Montreal, Can.

Treasurer—Victor Gelineau, director Board of Commerce and Navigation, State of New York-New Jersey, Jersey City, N. J.

Vice-presidents—1st, W. O. Hudson, president Board of Port Commissioners, New Orleans, a.; 2nd, J. Spencer Smith, vice-chairman New York-New Jersey Port & Harbor Development Co., Jersey City, N. J.; 3rd, Maj. Gen. Sir David Watson, president Quebec Harbor Commissioners; 4th, John H. McCallum, president Board of State Harbor Commissioners, San Francisco, Cal.; 5th, Chas. R. Francis, chairman Harbor Commission, Port of Chicago, Chicago, Ill.

Directors—William G. Ross, president Harbor Commissioners, Montreal, Can.; Maj. Gen. Lansing H. Beah, chief of engineers, U. S. A., Washington, D. C.; John N. Cole, commissioner, Dept. of Public Works, Boston, Mass.; G. B. Hegardt, engineer and secretary Commission of Public Docks, Portland, Oregon; Dr. W. T. Christensen, president Port of Seattle Commission, Seattle; E. L. Cousins, chief engineer and manager Toronto Harbor Commissioners, Toronto, Canada; Geo. F. Sproule, director Dept. of Wharves, Docks and Ferries, Philadelphia, Pa.

AMERICAN ENGINEERING COUNCIL

Much important business was transacted by the Executive Board of the Council at its Washington meeting. The presiding officers were Calvert W. Townley and J. Parke Channing of New York, vice-presidents. Progress was reported in the direction of establishing a Department of Public Works and confidence was expressed that the recommendations of organized engineering would be recognized in the final plan of government reorganization.

The Council adopted the report of the Committee on Patents, headed by Edwin J. Prindle of New York, urging the passage of the Lampert Bill to remedy conditions in the Patent Office, which, the committee asserted, were menacing the nation's industrial and agricultural welfare.

The Executive Board engaged in a long discussion of the report of the special Committee on Employment, finally appointing a committee of the board to draft resolutions which would crystallize the general thought brought out by the discussion.

In view of the business depression, it was decided not to hold an engineering assembly next January. The committee in charge of the arrangements was converted into a program and entertainment committee for the annual meeting of the Council to be held in Washington in January.

The application for membership of the Vermont Engineers Society and the Associated Engineers of Spokane were approved.

The board passed a resolution approving the decision of the National Board for Jurisdictional Awards in the Building Industry with respect to the award affecting the Brotherhood of Carpenters. The resolution expressed confidence in Rudolph P. Miller, American Engineering Council representative.

ALBANY ENGINEERS

The Albany Society of Civil Engineers and the Albany chapter, A. A. E. held a joint meeting on October 4th, which was addressed by Herbert S. Sisson, state highway commissioner, on "The Progress and Development of the Highway System of New York State."

HARVARD ENGINEERING SOCIETY

The Harvard Engineering Society held a joint meeting with the Harvard Club in New York on October 14th at New York City. At this meeting it was addressed by Clifford M. Holland, chief engineer of the New York and New Jersey tunnel commissions on "The Vehicular Tunnel," and by George A. Post, president of the Hudson River Bridge Corporation, on "The Proposed Suspension Bridge."

OFFICERS OF THE NATIONAL DRAINAGE CONGRESS

Clark E. Jacoby, engineer, Kansas City, was elected president of the National Drainage Congress at the tenth annual convention at St. Paul on September 22-24th; Jacob A. Harmon, Peoria, Ill., first vice-president; Dr. F. H. Newell, Washington, D. C., second vice-president; A. J. Bracken, Chicago and Memphis, third vice-president; William Kemper, Kansas City, treasurer; and J. H. Pratt, North Carolina; A. L. Maxwell and L. K. Sherman, Illinois; E. R. Jones, Wisconsin; Leroy Percy, Mississippi, and W. R. Compton, New York, directors. Kansas City was chosen as the 1922 meeting place.

CALIFORNIA SECTION, AMERICAN WATER WORKS ASSOCIATION

The annual convention of the California section, A. W. W. A., was held in Los Angeles on October 1st and 2nd. A number of papers and discussions featured the first day's session. The annual dinner was given that evening, when William Mulholland, chief engineer of the Los Angeles water department, talked on "The Los Angeles Water Supply and Distribution." On Sunday trips were made to points of interest on the Los Angeles water system.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The first meeting for the administrative year, 1921-1922, was held on October 19, 1921, at 8.00 P. M., Auditorium, Engineering Societies Bldg., 33 West 39th St., New York.

It was a joint meeting of the Metropolitan Sections of the four national societies, the A. S. C. E., the A. S. M. E., the A. I. M. E. and the A. I. E. E. Mr. Farley Osgood, chairman of the New York Section of the Institute, will preside. The subject for the evening was Financing of Large Engineering Undertakings.

The speakers announced were Arthur B. Leach of A. B. Leach & Co., bankers, New York, and Philip Cabot of White, Weld & Co., Boston. Other men of prominence in this field had been invited to present their views. Among those taking part in the discussion were John H. Delaney, former Transit Construction Commissioner, New York, followed by J. H. Williams of Day & Zimmerman, and others.

MONTREAL TOWN PLANNING CONFERENCE

The first town planning conference on Montreal was held on Sept. 29th-Oct. 1, and was well attended by town planners, architects, government officials, engineers and civic employees, also by numerous visitors. The Thursday session was held in French and the Friday session in English, while on Saturday the delegates devoted the day to trips of inspection to various places of interest from a town planning standpoint. Several interesting papers were read on street planning, automobiles and conduits, congestion in cities, geology of Montreal, and rapid transit. There were also about 100 exhibits, mostly of maps and photographs of town planning schemes; and an exhibit by the Air Board of photographs taken from aeroplanes, showing the great possibilities of usefulness in aerial survey work.

LOUISIANA ENGINEERING SOCIETY

At a regular meeting of the Louisiana Engineering Society, held October 10th, an address by H. G. Martin, on "The Delgado Trade School," was illustrated with lantern slides.

PERSONALS

Hastings, Dr. C. J., medical health officer for the city of Toronto, has been appointed head of the new Public Welfare Department of that city. He will continue as head of the health department, of which the Welfare Department will really be a branch.

Warner, Raymond A., formerly with the city engineer of Detroit, Mich., has been appointed assistant city engineer to H. R. O'Mara at Mt. Clements, Mich.

Conlin, C. J., formerly road engineer of Cuyahoga county, has been appointed construction engineer for the North Carolina state highway commission, District 4, at Durham.

Jones, R. L., has been appoined office engineer, division of engineering and irrigation, state department of public works.

Hays, D. W., has been appointed supervising engineer of the United Irrigation District, Alberta, Canada.

Muenster, Roland A., has been appointed assistant county road engineer of Bell county, Texas.

Watters, George E., has been appointed engineer of the Board of Water and Sewer Commissioners, New London, Conn., to succeed Walter H. Richards, who retired after fifty years of service.

Joyner, F. H., has been appointed assistant highways engineer for Los Angeles county, Cal., by the state highway commission, and will have charge of the general inspection for the southern district of that state.

Martin, C. A., has been appointed construction engineer on paving and sewer work for Puyallup, Wash.

Fletcher, George A., former city engineer and waterworks superintendent, died recently in Pitcher, Okla., at the age of 57.

Allan Garratt has opened an office in Boston for consultation and advisory work in hydraulic engineering.

Voorhees, S. S., one of the technologists of the U. S. Bureau of Standards, died in Portland, Me., on September 24th.

Hudgins, F. D., formerly with the bureau of public roads at St. Paul, has accepted the position of state highway engineer for South Dakota, with headquarters at Pierre.

May, Charles A., assistant state highway engineer of New Mexico, has been appointed state engineer.

Kennedy, Leo, has been appointed civil engineer for the Happy Valley Irrigation District, Cal.

Bernier, J. A., has been appointed civil city engineer of Shawinigan Falls, Quebec.

Schuyler, Philip K., formerly in the bridge department of the Wisconsin highway commission, has taken a position with the bridge department of the North Carolina highway commission at Raleigh.

Harcourt, Ralph, mayor of Longport, N. J., has tendered his resignation to the borough commissioners, to take effect immediately after the election of his successor.

Kirk, Robert E., deputy county surveyor of Hennepin county, Minn., died recently at the age of 74.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

ROAD SCRAPING WITH "REPUBLIC" TRUCKS

The Republic Truck Sales Corporation, of Alma, Mich., is now equipping their 2½-ton trucks known as the "Republic Good Roads Maintaining Truck," with a Root spring scraper for use in maintaining gravel and other roads. The scraper attachment has been mounted on other size trucks, but the best satisfaction seems to be obtained from the 2½-ton, as this motor is of sufficient power to give the desired lugging power at slow speed and the truck has sufficient weight to hold the scraper hard against the ground. A speed of between 8 and 12 miles an hour seems to be most satisfactory, at which speed all holes and ruts are evenly filled.

The scraper itself consists of a blade edged with 3-8 inch by 2-inch steel mounted on four steel springs 6 inches wide, which in turn are mounted on a round, hollow bar which is adjustable by means of a chain and ratchet post. The bar is mounted on a 2x6-inch oak timber through adjustable brackets, and this timber is then mounted on the chassis frame with heavy brackets and substantial braces. When not in use the scraper is raised and gives a clearance of 8 inches under the lowest point.

To provide for night work where the traffic is too heavy for day maintenance, special lights are attached and operated by the motor-driven generator and storage battery for effectively lighting each side of the road.

While this unit was primarily built for maintaining gravel roads, a number of commissioners have placed it in immediate service for filling in the ruts worn on roads that have been newly graveled.

The managing engineer of the road commission of Kent county, Mich., O. S. Hess, reported a few weeks ago that he had started last year with two of these scrapers and had put three more in operation this season, all for use for maintaining gravel roads. One of these, he states, will cover about the same mileage of road in a day that would ordinarily be taken care of by 6 team patrols equipped with light graders or floats. They cover long stretches of road in a very short time, as during or immediately after rains, which it is impracticable to do with floats and light scrapers. He is maintaining about 250 miles of gravel roads and still uses a number of team patrols, but is gradually supplanting them by spring scrapers on the heavily traveled lines, decreasing the total maintenance cost and giving better roads continuously. He compares the cost on the basis of a truck scraper covering 80 miles a day and 6 teams covering the same distance. In this comparison the cost of the truck is $2.30 for gasoline at $.23 a gallon, $.50 for oil, $2.94 for deterioration of truck, $3.00 for deterioration of tires and $5.00 for driver, a total of $13.74. The 6 teams at $.60 per hour cost $36.00 and deterioration of the 6 scrapers $3.00, giving a total of $39.00. This gives a saving of $25.,26 or more than $3,000 a year on the basis of 6 months operation with 20 working days a month. He reports that the scrapers also work well in snow when this is not too deep.

INDUSTRIAL NOTES

The Engineering Equipment & Supply Co. has been absorbed by the J. E. Heatton Co., dealers in machine tools, contractors' machinery, etc., and offices are now at 30 Church Street, New York City.

The Standard Steel Works, Kansas City, Mo., has moved into its new plant in North Kansas City, where it will manufacture Standard steel dump bodies, hand hoists, truck tanks, roadworkers' equipment and a complete line of mill and elevator equipment.

E. E. Aldous has been appointed St. Paul, Minneapolis and Duluth representative of the American Steel & Wire Co., Chicago.

The Central Steel Co., Massillon, sillon Rolling Mill Co. and the National Pressed Steel Co., and will carry out all the valid contracts and obligations of the other two companies.

The Republic Truck Co., Inc., of Alma, Mich., at its annual meeting on September 29th elected the following board of directors for the coming year: John N. Willys, W. P. Chrysler, J. E. Kepperley, E. C. King, W. J. Baxter and H. I. Shepherd, all of New York City; Frank E. Smith of St. Louis, Mo.; T. A. Burt, Urbana, Ill., and Francis King, Alma, Mich.

The Schaffer Engineering & Equipment Co. has combined its administrative, sales and manufacturing departments in its new general office adjacent to the factory in Pittsburgh, Pa.

The Arthur Sachsse Corp., New York, has been formed by Arthur Sachsse and Felix F. Wiener, to promote the sale of patents, formulas and processes, dealing principally with inventions made during the war in Germany, and offering manufacturers' rights to American firms.

The Yeomans Bros. Co., Chicago, manufacturers of sewage ejectors and drainage pumps, announces the following new representatives: P. E. Fallon, Little Rock, Ark., and Morton McI. Dukehart & Co., Baltimore, Md.

Thomas N. Gilmore has opened an office in New York City as consulting engineer specializing in lay-outs and designs of railroad shops, locomotive terminals, power plants, steam stations and industrial plants and in the improvement of these facilities. Mr. Gilmore has been connected with Westinghouse, Church, Kerr & Co. for the past 16 years, in charge of railroad shop design and construction and later as vice-president and chief engineer in charge of all engineering and construction.

GRANITE FLOOR SLAB TESTS

The Cement Gun Co., Inc., and the Consolidated Expanded Metal Cos., announce that at noon on October 26th at 263 Monitor St., Green Point, Brooklyn, fire, water and load tests will be made of Gunite floor slabs reinforced with "steelcrete" expanded metal, in order to determine the acceptability for fire proof buildings in compliance with the requirements of the fire department of New York City. The 21-foot 7-inch by 16-foot 4-inch slab 2¾ inches thick made with 1 to 3 Gunite with panels of 6-foot 3-inch, 18-foot 6-inch and 6-foot 10-inch spans loaded to 40, 150 pounds and 50 pounds respectively, will be subjected to 1700 degrees temperature, quenched with a 60-pound hose jet through a 1⅛-inch nozzle. Applied for 5 minutes on both upper and lower surfaces of the slab.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y. August 27, 1920, under the Act of March 3, 1879

Vol. 51 OCTOBER 29, 1921 No. 18

Concrete Test Highway at Pittsburg, California

By Charles Geiger

Recently completed, with some new features for determining deflection under loads, elongation of reinforcement, effect of moisture on stability of adobe soil, and other points concerning which there are not any definite data.

A test highway has just been built at Pittsburg, California, which embodies several unusual features. It is an elliptically shaped roadway of plain and reinforced concrete, 18 feet in width, 1,371 feet in length on the center line and comprising 13 sections of pavement differing in design as well as in the quality and location of reinforcing.

The purpose of the test is to determine by observation under the same conditions of wear and on the same subgrade, the relative merits of different materials and cross-section design and at the same time to develop, if possible, an improved type of plain and reinforced concrete pavement. The conditions of the test are such and the participation of eminent engineers of such a nature that the results, it is believed, will be of the utmost value to state, county and city road and street builders.

The test highway was built on black adobe, and by means of side ditches into which water can be turned, each section will be flooded during the tests and then dried out. Borings will be taken at regular intervals in the subgrade for soil samples (holes having been left in the concrete slab and filled up with wooden plugs for this purpose) to determine the moisture content of the soil. From observations taken in four tunnels which have been constructed under different sections, the relationship between the moisture content of the subgrade and its bearing power under traffic will be learned.

The tunnels have been constructed with their roofs a little over three feet below the top of the subgrade. These were constructed for the purpose of taking observations on the under side of slabs, to determine the effect of various truck loads and speeds on the flexure of the slabs as well as on the subgrade. Self-recording instruments are to be used in each tunnel which will indicate, directly, the flexure caused by loads on top of the pavement. These tunnels have been equipped with electric fans to keep them cool and well ventilated for the observers who will be stationed

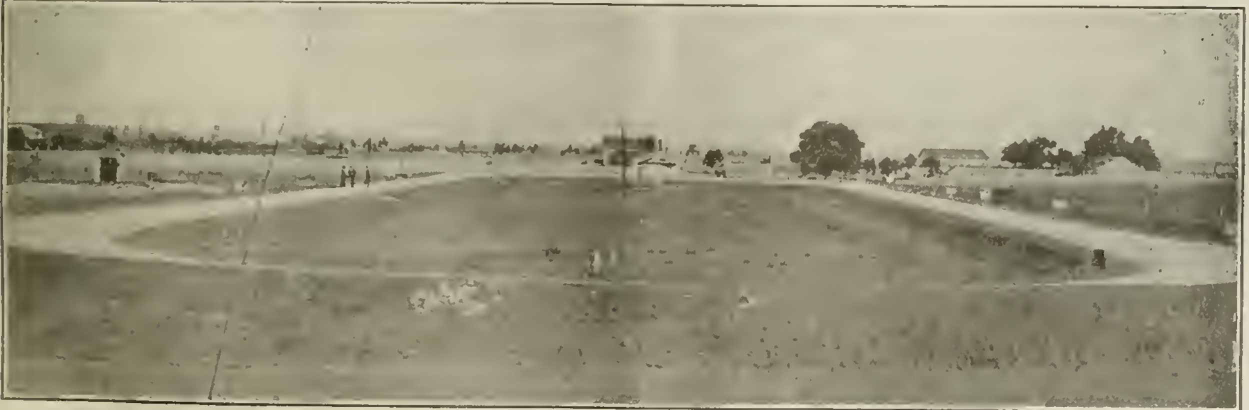

FIG. 1—TEST HIGHWAY, BUILT IN THE SHAPE OF A RACE TRACK

here. It is believed that this is the first time that provision has been made to make observations from the under side of slabs.

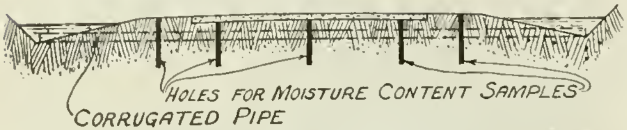

FIG. 2—CROSS SECTION OF ROAD SHOWING PROVISION FOR FLOODING

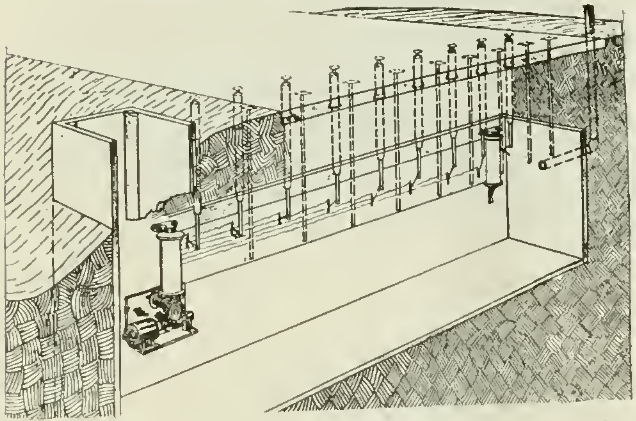

FIG. 3—SECTION OF TUNNEL, SHOWING APPARATUS INSTALLED IN TUNNEL

That adobe soils present most difficult problems for road building is recognized by highway engineers. Their characteristics of increasing or decreasing in volume as their moisture content becomes greater or less causes them to exert forces whose amount and direction of action are understood to only a very limited degree. It is well established that their power to support loads depreciates as the moisture content increases, but the law or rate of their depreciation is understood imperfectly. This quality induces a condition that causes the subgrade to be affected in an unusual manner by traffic forces. The amount of influence of the traffic on the adobe is tempered by the ability of the pavement to distribute forces over the subgrade or foundation.

The provisions shown in the cross-section Fig. 2 for flooding each section and then drying out, will permit making determinations that have been impossible in previous test roads.

In Figs. 1, 2 and 3 a number of rods ¾ inch in diameter and 5 feet in length have their upper ends imbedded in the concrete slab, and their lower ends extending down into the tunnel about 9 inches. In order to keep the water from entering the tunnels when the side ditches are flooded, as shown in Fig. No. 5 they pass through a pipe and a rubber hose. Both ends of the pipes are tapered and the lower ends extend down through the roof of the tunnel. To the upper ends are attached rubber hose about 12 inches in length. The upper end of the hose is embedded in the concrete slab about one inch. When a truck passes over the concrete slab, this arrangement permits the slab to sag, and at the same time keeps all water from the tunnel. Attached to the lower end of each rod is a self-recording pen. As the motor trucks pass over the concrete slab, these pens make a record on the record sheet, which moves from one to four inches per minute, being driven by a small electric motor placed in the tunnel. These rods will record the flexure of the concrete slabs. Other rods, shown in the same illustrations, will record the flexure of subgrade. To the lower ends of the subgrade flexure rods will be attached verniers. Moving pictures will be made of the movements of the rods from time to time which will show the least movement of the rods.

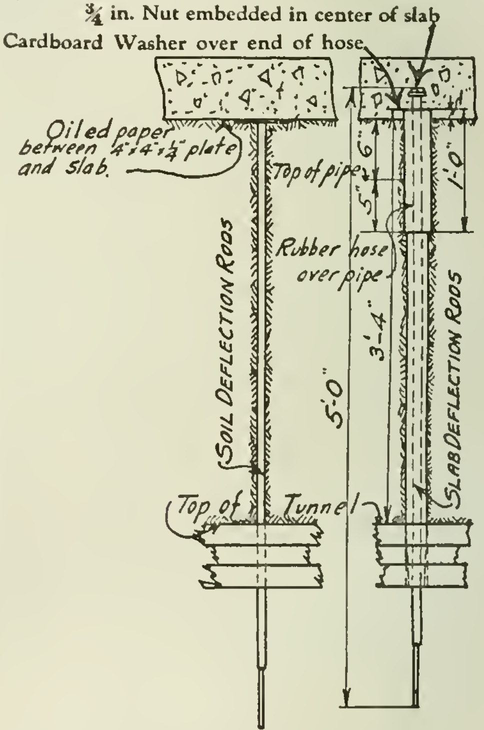
¾ in. Nut embedded in center of slab
Cardboard Washer over end of hose
Oiled paper between 4"×4"×¼" plate and Slab.
Top of pipe
5'-6"
1'-0"
Rubber hose over pipe
3'-4"
5'-0"
Soil Deflection Rods
Slab Deflection Rods
Top of Tunnel

FIG. 5—DETAILS OF DEFLECTION RODS

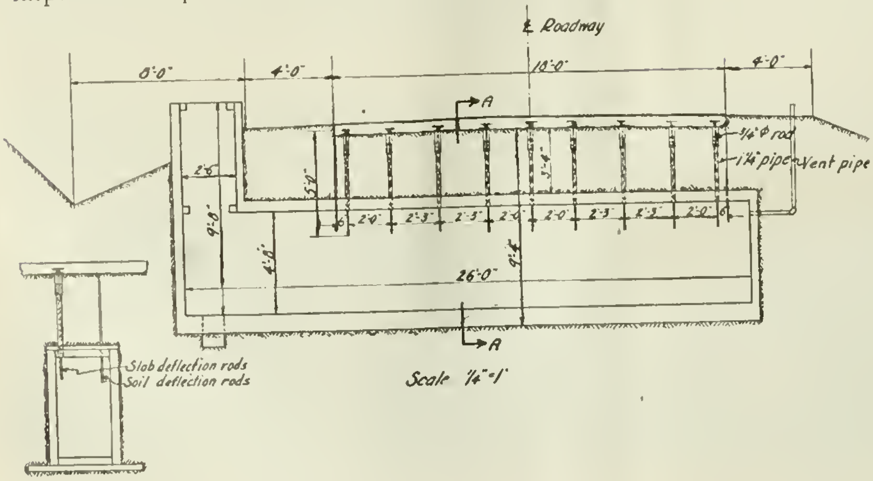

FIG. 4—SECTION THROUGH INSPECTION TUNNEL SHOWS DEFLECTION RODS EXTENDING THROUGH PIPE SLEEVES

A fleet of motor trucks will be run over the highway until the test road is tested to destruction. Complete check of the results at all stages will be made so that at the conclusion of the test the results will be available in practical form and used to advantage in determing what types of construction are best adapted to California soil conditions.

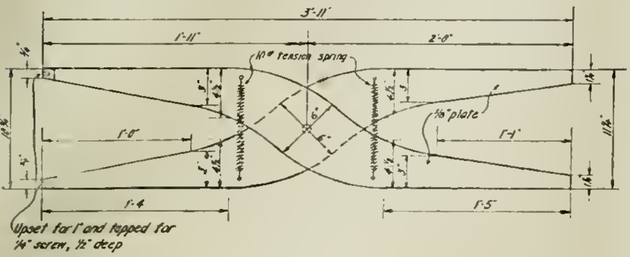

FIG. 6—FORKED EXTENSION FOR EXTENSOMETER

The extensometer will also be used to measure the elongation of the bottom of the reinforced slabs, as the motor trucks pass over the section of pavement over the tunnels. This is the first time, it is believed, that the extensometer has been used for this purpose. In order to make this determination a steel device called an extension is used to transmit the movement of one of the reinforcing rods in the bottom of a slab to the extensometer, which will be operated from the main tunnel. A drawing of this extension is shown in Fig. 6. Holes 10 inches apart were drilled in the under side of one of the steel reinforcing rods and a thimble placed around the holes so that the concrete could not flow in when pouring the pavement. Two pointed pieces of steel, screwed into the ends of the extension were designed to fit into the two holes in the steel reinforcing rods. The extensometer will be applied at the opposite end of the extension. Readings will also be taken with this instrument on top of all slabs.

A complete system for making a record of all cracks as they appear has been worked out by marking the test road off into 6-foot squares, and as the cracks appear they will be plotted on a chart.

A novel method was employed in preparing the subgrade for section A, as shown in Fig. 7, where a loose rock fill was made on the subgrade. After the grade had been properly prepared, by scarifying, sprinkling and rolling, and before the header boards were placed in position, the middle portion of the grade was treated as follows: An excavation was made in that portion of the grade between the limits of 2 feet outside the lines for the header boards, or 11 feet either side of the center line. This excavation varied in depth from four inches at the edges to twelve inches in the brought to a surface of 2 inches below and paralment, and was filled with loose rock (oversize or waste rock) ranging in size from four inches on the bottom to one inch on the top. Care was taken to have the larger rock on the bottom, with many voids, to insure ample drainage. At various points trenches were dug to connect with the gutters, and the trenches filled with rock in the same manner. The rock fill was rolled by a three-wheeled road roller weighing ten tons and brought to a surface 2 inches below and parallel with the bottom of the pavement. Then loose dirt was spread over the rolled rock for a width of 9 feet either side of the center line, and rolled Sufficient dirt was added so that it would be a little higher, when rolled, than theoretical subgrade elevation. The pavement was then laid on this subgrade.

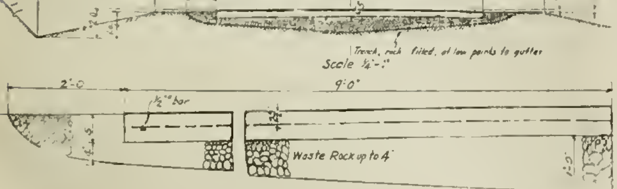

FIG 7—HALF-SECTION OF SECTION A, SHOWING ROCK FOUNDATION

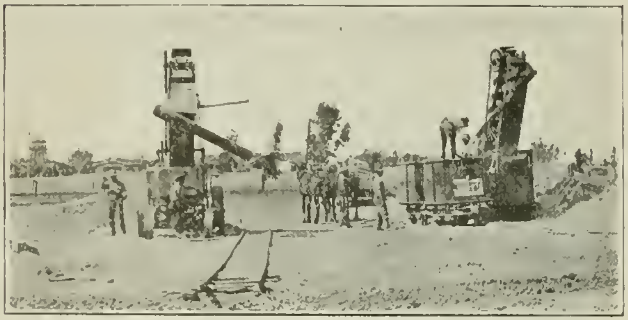

FIG. 8—LOADING BROKEN STONE AND SAND INTO BATCH BOXES, TWO TO A CAR THAT ARE HAULED ON RAILS ALONG SHOULDERS OF THE TEST ROAD

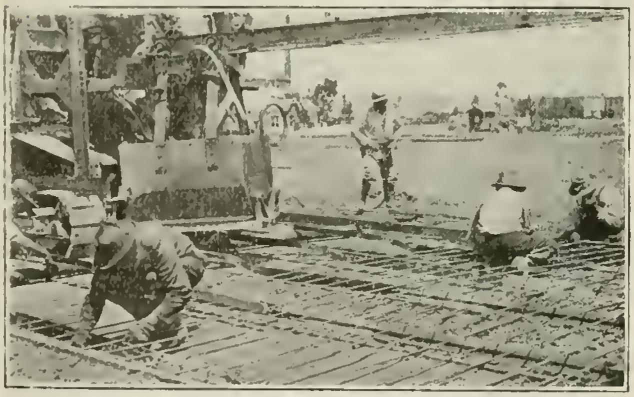

FIG. 9—USE OF CRADLE FOR PLACING REINFORCEMENT

One of the purposes of this test highway is to develop, if possible, an improved type of reinforced concrete pavement. In line with this purpose, two of the 13 sections that have been laid were reinforced with a special steel of very high tensile strength and provided with an extra bond to make the full strength available, which is expected to strengthen the slab more than would be feasible even with an excessive amount of commercial grade steel. This steel was developed expressly for road building purposes by the Columbia Steel Company of Pittsburgh, California, which constructed the test pavement. In addition to the two sections in which the special steel was used, as many other designs as possible were sought from the state highway commission, county highway commissions, and individuals.

Many interested individuals and firms are cooperating in this test. Cement, sand and gravel for this test road were contributed by interested firms, equipment for the construction was loaned by manufacturers, a contractor undertook the work for the bare total of force account and expenses, all testing work is being done gratis by a San Francisco firm of testing engineers, trucks will be donated, and the cost of drivers and mechanics will be paid by the Motor Car Dealers' Association of San Francisco.

While the test is under way, sections of the road that give away first will be repaired so that the whole road will be usable until its last unit fails under the strain. This will afford a valuable opportunity to observe results of various types of repair work, a matter of particular interest as so many of the state highways are now undergoing reconstruction.

From 3,000 to 4,000 vehicles will pass over the road each day, the average weight of vehicle and load being about eight tons. A set of scales with a capacity of 50 tons has been installed for weighing the trucks taking part in the test.

Observations will be made of the results of this traffic and later, when some of the stronger sections fail to yield, War Department equipment will be used to complete the destruction.

In the construction of the test highway a novel method was employed to insure accurate placement of the steel reinforcing. This was done by means of a cradle, consisting of angle irons and pipes anchored to an 18-foot pipe 4 inches in diameter. This pipe was attached to the concrete mixer and served as a pull bar. As the concrete mixer moved forward the angle irons and pipes were pulled out, leaving the steel rods in place, and leaving very small voids in the concrete, which were filled by the adjacent concrete flowing into them.

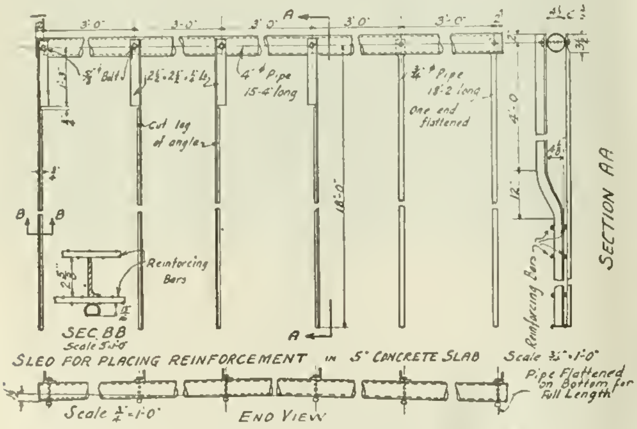

FIG. 10—SLED FOR PLACING REINFORCEMENT IN CONCRETE PAVEMENT

The 13 sections vary from 150 feet to 45 feet in length, and from 5 to 8 inches in thickness. All are 18 feet wide. Only section A has the rock fill subgrade, the others all being laid directly on adobe. Four sections are without reinforcement. In the other nine the reinforcement varies from 20 tons per mile to 69 tons. In three sections the reinforcement is placed diagonally. The four tunnels cross under sections B, D, G and I, having, respectively, 20, 55, 69 and 24 tons per mile of reinforcement.

Carrying Power of Odors

Difficulty of making mathematical measurements of intensity of odors or of describing their nature. Some instances cited.

Two or three years ago residents of the borough of Richmond, New York City, were very much wrought up by the location there of a garbage reduction plant for treating the garbage of three of the other boroughs of Greater New York and brought successful suit to prevent the operation of the plant on the plea that it was creating a nuisance. Active in the prosecution of this case was Louis L. Tribus, consulting engineer of New York City and residing in that borough and, probably as a result of his investigations at that time, together with the employment of his firm more recently in another nuisance case, he has collected considerable data on the matter of odors from such plants, which he has presented before the American Society of Civil Engineers under the title "Odors and Their Travel Habits," which paper is published in the August number of the proceedings of that society.

He calls attention to the fact that objections to odors may be sentimental rather than justified by actual nuisance, while on the other hand there may be a tolerance of them bred by acquaintance or induced by personal advantage.

One of the difficulties of dealing with the subject is the fact that mathematical measurement of odors is impossible. "One cannot say that a particular odor, given off at a specific heat, meeting a certain open air temperature at a certain barometric pressure and known degree of humidity, with a wind blowing just so many feet per second over a level plain, will be clearly noticeable at a computed distance from its source." Probably six simultaneous observers would not use the same adjective in describing any given odor, but if it is objectionable the adjective is inessential; the real point of importance is the distance that the odor travels. Since odors will travel, litigation will necessarily result and will have to be settled in some way.

Several instances of odors were cited by the author. The garbage reduction works at Barren Island (within the borough of Brooklyn, city of New York) for several years gave off fumes from the retorts and tankage dryers which traveled 5, 6, or more miles, according to wind and humidity, before diffusion and chemical break-up relieved the offense. "These odors, while disagreeable, were not particularly nauseating to most people and for many years legal actions to end them were not effective. Recently, however, a permanent injunction has been granted. Close to the plant, although intensified, the odors were scarcely more offensive than at considerable distances."

An injunction having been granted against the operation of the Barren Island plant, one was located at the south end of Staten Island (borough of Richmond) to replace it. This new plant was supposed to be the latest word in garbage reduction and to avoid as far as possible the creation of odors or other nuisance. However, Mr. Tribus says that these works "for several months of operation prior to its being closed as a nuisance gave off gases that persisted in nauseating quality and strength to points 8 and 9 miles away. Rather curiously, although 24-hour operations were maintained, these peripatetic smells became more offensive after sundown. Evidently, the sun's rays possess a deodorizing power which was joyfully welcomed by the burdened population through those months of torment.

"Years ago it was discovered, practically by accident that sunlight streaming into a tank holding tried-out seal oil, while going through the curing process, killed in large measure the exceeding vile odors of decomposition, and these made life undurable for the workmen."

The state of New York for years maintained action against New Jersey to enjoin the emitting of corrosive gases and offensive odors from certain large manufacturing plants in Bayonne. Some of the defendants gathered some of the worst gases into two great chimneys, which they left at a height of 360 feet above the ground. "While the eye can see the output drifting for several miles, diffusion and perhaps transformation largely occurs before the odorous gases descend to ground level again, unless a strong wind blows them earthward to produce their old-time results of throat and nose irritation." Further north in New Jersey, odors given off in the preparation of certain chemical and other commercial products were intensely irritating to the residents of New York City more than a mile away across the Hudson river.

The author states that the peculiar and rather pungent odors of tropical vegetation in the West Indies can be discerned 25 or 30 miles before the islands are reached by boat but suggests that the ocean itself may transport the odors to a certain extent in the stream flow and land washings that it receives. This suggests that gases may be absorbed by water to be given off again some distance away, as, for instance, volatile elements from the effluents of sewage treatment plants seem to be carried in flowing streams for considerable distances. In such cases, however, the gases when liberated do not usually travel far from the stream itself. "Even in the case of the lower Passaic river, Gowanus creek and formerly the Chicago river, the well-known trio of unenviable waters charged to practical saturation with sewage, the odors were not noticeable usually for more than a few blocks away from their banks."

Mr. Tribus quotes a few brief sentences from the testimony of experts in the suit by Richmond borough to enjoin the operation of the plant before referred to, known as the Lakes Island reduction plant: "Odors travel greatly under light air and high humidity." "Garbage scow smells are noticeable from 1/3 to 1/2 mile." "Odors travel 3 to 5 miles, increasing with quantity . . . night travel is more offensive than day." "Odors carry, say, 3 miles." "Odors not so offensive with high winds." "Garbage odors will travel long distances." "Odors would not carry far."

Economical Blasting With T. N. T.

A new method for firing T. N. T. in propagated ditch blasting which greatly reduces labor costs and saves time has been evolved by the State Board of Health of Greenwood, Miss., in deepening the Walker's Lake canal. J. Lyell Clarke, sanitary engineer of the boards, says:

"Work on the canal was discontinued when attempt was made to fire T. N. T. in water by priming each charge with an electric cap connected in series—the usual method. Owing to the leakage of the electric current through water, this method proved a failure, caused misfires and resulted in a labor cost almost prohibitive.

"T. N. T. being very insensitive will not explode by the propagated method, so in an effort to reduce the two main items of cost of ditch blasting, which are labor and caps, a new method has been evolved. Tests were made wherein 1/4 pound charges of 50 per cent straight dynamite were used in lieu of electric caps. Knowing that concussion from the explosion of one primed charge placed in the center of a line of charges of 1/4 pound of dynamite, spaced at intervals of 18 inches, would be transmitted throughout the entire line and cause almost simultaneous combustion, it was thought that the explosion of the top charges of dynamite would in turn detonate the large charges of the more insensitive T. N. T. placed beneath it. This it did.

"The top charges of dynamite exploded the T. N. T. more completely than did the electric caps, shattered the top soil and lifted it well back, gave the T. N. T. an opportunity to heave out the bottom strata in good form and in addition thereto eliminated the cost of priming each hole, the cost of connecting the caps in series, and the cost of re-shooting misfires. Only one cap was required to set off one hundred charges. The resulting ditch was wider, larger and more uniform than that constructed with the T. N. T. detonated by an electric cap placed in each charge; besides, the work was speeded up about 200 per cent.

"The cost of blasting a ditch 10 feet wide at top, 3 feet wide at bottom and 4 feet deep, with charges 1 1/4 pounds of T. N. T. (or picric acid) detonated with 1/4 pound charges of 50 per cent straight dynamite spaced 18 inches apart, is approximately $750 per mile; or 14 cents per cubic yard of earth removed. Six laborers under average swamp conditions can blast one mile of ditch in one week."

Government Contracts

American Engineering Council would limit number of cost plus contracts, standardization of contracts, and prompt payments. Employment bureau for engineers.

After careful investigation and deliberation the executive board of the American Engineering Council has just recommended that:

"Whereas, the need is pressing for a unified employment service for engineers, national in scope, local in application, and financed for adequate service, and

"Whereas, the contributions which the constituent societies of the Federated American Engineering Societies are able to make to the Employment Bureau have been found inadequate to provide an employment service such as engineers require, therefore, be it

"Resolved: That the Executive Board of the American Engineering Council endorses in principle a paid employment service but in the reduced fees to members of organizations supporting said service, and be it further

"Resolved: That a committee of five members of the Executive Board be appointed by the chairman and that the Boards of Direction of the four founder societies be requested each to appoint a member of its board in order to form a joint committee of the nine members on engineering employment in the power to organize an employment bureau, on a plan which will invite the co-operation of interested organizations."

The question of government contracts was thoroughly discussed by the board which made important recommendations:

"That government work be normally carried out through unit price, or lump sum contracts, or by the purchase and hire method. Where none of the above methods are applicable to conditions, that the cost-plus method be used in which the contractor is refunded the actual cost of the work, plus an accorded compensation which increases if the work is done below the estimated cost of the work, and decreases if the work costs more than estimated, but never sinks below zero;

"That there be appointed by the president an Inter-Departmental Board on Standardization of Contracts, consisting of one representative of each government department engaged in construction. That this board recommend policies to govern in the standardization of contracts within each department. Each department should have a small board representative of each bureau engaged in construction, and should seek to unify and standardize contract practices within the department, and the chairman of these departmental boards might preferably constitute the inter-departmental board, which should be only advisory in character. That when the contracts of each department shall have been by itself thus standardized, that the Inter-Departmental Board consider these contracts and make necessary recommendations to harmonize and secure, so far as feasible, uniformity of practice in the different departments;

"That all government officials shall recognize the importance of exerting the utmost efforts to take prompt partial payments on government contracts at reasonable intervals as stated in the contracts, for all services rendered and materials delivered by the contractor, on the work that has been accepted by the government inspector;

"That payment shall in all cases, as far as possible, be made by the official or agency directing the work, and not by an outside accounting or financial agency, in order to avoid the burden on the contractor of delays in payments when made by such agency not directly concerned with, or responsible for the efficiency, economy and dispatch of the work."

Relieving Unemployment By Construction Activities*

Vitally changed conditions, competition, United States co-operation, capacity to increase employment, freight, materials and financing are all important factors.

The rapid evolution in this country from an agricultural to an industrial nation and the change of the majority of the population from rural to urban dwellers and consequent dependence on continuous employment, have not so far been adequately provided for and now demand business co-ordination. An important factor of the present industrial condition and lack of employment is the development of trusts producing cooperation between producers, wholesalers and retailers in which the consumer gains little advantage.

We now face either a complete or a partial recognition of the co-operating principle of industrial business. Complete recognition involves a practical, economic revolution that would paralyze industry for a time and it is even doubtful if we are ready for co-operation in the production of the five great raw materials, namely: coal, iron, lumber, oil and copper, but we should not hesitate to take a step toward co-operative business organization. The question should be whether to reorganize one or more industry, preferably one, at the present time.

Unemployment may be mitigated, but not reduced, by [limited?] employment, providing a clearing house for laborers and work, and by reducing working hours or employing alternate shifts. The construction of public work in conjunction with other measures is advisable when assured of the co-operation of the public officials, industrial leaders and the public at large. The ability of public and private construction to aid unemployment is dependent one on the other, with the industries for construction market; on shortage and demand for construction; on capacity to increase employment; on causes delaying construction and steps necessary to revive construction.

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*Abstract of memorandum submitted to the President's Unemployment Conference by R. C. Marshall, Jr., General Manager of Associated General Contractors of America.

Construction is the key to about 40 industries affording employment to greater numbers than construction itself. The potential demand for private and public work is estimated to be at present about $15,000,000,000, including $5,000,000,000 for home construction, $5,000,000,000 for railroad construction, $2,000,000,000 for public utilities, $2,000,000,000 for public roads, $1,000,000,000 for reclamation and irrigation, commerce and hydro-electric work.

The approximate ratio between the amount of labor employed in construction and in the six basic industries is estimated at about 2½ to 1. The employment of 2 men in the field therefore means a total of 7 in the whole construction group. It is believed that if a large part of public work, for which appropriations are available is started in November, employment could be found for nearly 1 billion men within 90 days.

Construction has been delayed on account of the increased cost of labor, material, freight rates and financial charges. It is believed that the average cost of labor and material are now about 60 per cent greater than in 1914 and allowing a natural regular increase of about 20 per cent in that period they may be considered 40 points above normal at the present time. Any saving that might be effected by waiting for lower labor and material costs will be insignificant compared with the expense of any system of charity that might be necessitated by further postponement of work.

If construction is delayed until producers in the basic industries are driven out, the supply of materials will become so low that prices may move rapidly upward and we must therefore look beyond labor and material costs to reduce construction prices enough to stimulate the present demand.

Freight rates on construction materials are discouraging and sometimes even prohibitory. In some localities they are 129 per cent above the 1917 charges, amounting to as much as $11,000 per mile for an 18-foot concrete highway, and unduly keep up the cost of construction and prevent its revival.

Interest, bonus, premiums and other financial charges on money loaned for construction purposes have been excessive, amounting in some cases to from 18½ per cent to 30 per cent and causing many projects to be postponed or abandoned.

In order to give efficient government aid to construction it has been recommended that all federal, state, county and municipal work for which appropriations are available should be immediately put under construction; that necessary contemplated appropriations should be promptly made and that federal and state governments should co-operate on reclamation work; that a home loan agencies should be established to furnish money at reasonable rates for housing construction; that freight rates should be adjusted on construction materials; that railway claims should be paid, enabling the companies to undertake improvements and extensions; that unlawful or injurious combinations and agreements in finance, building and material production should be investigated; that private construction should be encouraged by tax exemption; and that the Federal Power Commission be enabled to pass on private power prospects.

The paper concludes with the recognition of the danger of a very serious effect from the sudden expansion of construction materials prices when artificial stimulation is attempted. "Unless constructors, material producers and labor are willing in this emergency to accept reasonable profit and reasonable wages, any intensified construction program may end in disaster . . . since we should not attempt to arbitrarily regulate prices, assurance of reasonable prices must come from the far-sightedness of industrial leaders who know the ultimate benefit of steady prices, wages and market and from the force of public opinion. It is with these considerations in mind that stimulation of construction is recommended."

Road Resurfacing In Sullivan County

Unscarified macadam covered with two inches of water-bound macadam and three inches of bituminous macadam. Spraying sixteen feet width in one trip.

By W. A. Hardenburgh

Good management by the contractor and a somewhat unusual method of resurfacing are among the interesting points in a four-mile state road resurfacing job between the towns of White Lake and Monticello, Sullivan county, New York. The work is also interesting as showing what might be called standard road construction practice by the contractor, for the firm doing the work —De Graff & Hogeboom, Inc., of Kingston, N. Y.—has followed road construction for many years. A sample of the way the work was handled is shown by the fact that within ten minutes after the last stone had been crushed the work of dismantling the crusher was well under way.

In the resurfacing, the old road was neither cut down nor scarified. An "evener" course of broken stone was laid on top of the old roadbed, and thoroughly rolled. On top of this was laid the new surface. This plan has the advantage of preserving intact the old road as a solid and well-compacted base, while saving labor in scarifying and reshaping.

The new surface, which was laid on top of the "evener" course, consisted of two coats of bituminous material, totaling 2¼ gallons per square yard and 3 inches of crushed stone. The "evener" course was of No. 3 stone, and of an average thickness to give two inches of cover when well rolled. On top of this was placed 3 inches of No. 3 stone, which was thoroughly rolled. Bituminous material A of the state specifications was then applied at the rate of 1¾ gallons per square yard. The voids in this course were filled with a thin layer of No. 2 stone, which was rolled in. On top of this was spread ½ gallon per square yard of bituminous material, and this was covered with a thin coat of No. 1 stone. The old road was of bituminous macadam 7 inches thick. The five inches of resurfacing gave the road a total thickness of 12 inches.

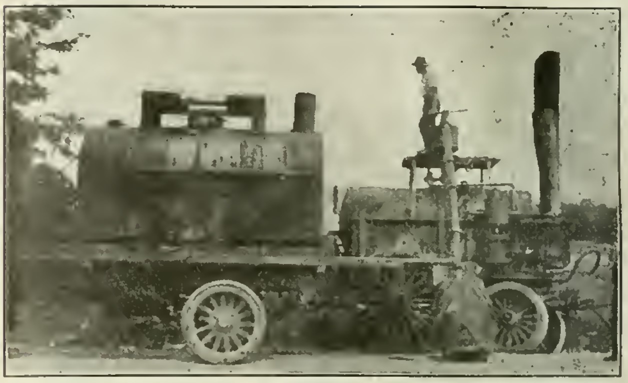
The contract also called for widening the road from 14 to 16 feet. One foot of width of standard bituminous macadam was added to each side of the old road, which had proved too narrow for traffic. Cleaning and reconstructing ditches and shoulders was also required by the contract.

Field stone, secured from stone walls, stone piles and the neighboring fields were used. Teams were employed entirely on the work of hauling stone from the field to the crusher, as on work of this sort a motor truck becomes mired or otherwise delayed frequently. A Climax crusher, steam engine driven, set up at a point about midway of the strip to be resurfaced, furnished the stone. No coarse stone were used, so tailings were recrushed.

Except on the shortest of hauls, crushed stone was handled by motor trucks; on very short hauls teams were used. Two Brockway trucks, of 2 and 3½ tons capacity, respectively, were used for hauling stone. These were equipped with solid tires, but were rarely used off the main road.

Spreading of the stone was entirely by hand, the men using stone forks. A Buffalo-Springfield 10-ton roller was used for compacting the broken stone. There was no appreciable amount of excavation; even the reshaping of shoulders and the reconstruction of ditches involved very little excavation. A Climax Jumbo road scraper was used on this part of the work.

APPLYING BITUMINOUS MATERIAL TO ENTIRE WIDTH OF PAVEMENT AT ONCE


PUMPING OIL FROM MOTOR TRUCK TANK TO OIL SPREADER

The bituminous material for the road was hauled by a "King" motor tank truck from Monticello, about six miles away. The tank contents were transferred by hand pumping from the motor tank truck to the oil sprayer.

By means of extensions to the spraying bar, the entire width of the road was treated with bituminous material at one time, not only saving time, but also giving a more uniform application. The sprayer was hauled by the steam roller, which also furnished steam for heating the oil and for putting it under pressure.

Italian labor was employed mainly, the men being housed at a camp operated by the contractors. The average pay of the 50 men employed on the work was about $3.50 per day each. The contractor also furnished his own teams and wagons—Eagle wagons were used.

The total cost of the four miles of resurfacing along with ditch cleaning and reconstruction and remaking of the shoulders, was about $57,000. Mr. Hogeboom was in charge for the contractors. A. L. Bush was engineer in charge of the work for the State Highway Department, and J. L. Scully resident engineer.

Sewage Disposal at Akron

Owing to the rapid growth of Akron during and since the war because of the enormous expansion of its industries, the sewage disposal plant completed a few years ago has already been greatly outgrown and can now treat only about half of the sewage. The other half is necessarily being discharged into the Cuyahoga river and this has been the cause of persistent complaint from the township below. It is expected that the state board of health will order the city to increase the capacity of its treatment plant so as to purify all of the sewage. The city engineers estimate that the cost of the addition to the plant will be approximately $1,000,000. Plans have not been made for it yet and it is doubtful if construction will begin before next summer or fall even if the construction of the plant should be decided upon at once.

The present plant was built in 1915 and was described in "Municipal Journal" for July 15 and 22. At the same time and on the same site there was built a garbage reduction plant which was abandoned last year, hog feeding being substituted.

PUBLIC WORKS
Published Weekly
by
Public Works Journal Corporation

Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba. $3.00 year
All other countries .... $4.00 year
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Psychology and Sewage Sludge Disposal

In a paper read before the American Society for Municipal Improvements this week and describing how the Rochester sewage disposal plant gets rid of its sludge, N. Adelbert Brown, the engineer in charge of the plant, makes statements that may suggest to other cities a means of inducing farmers to take sludge off their hands for use as a fertilizer.

It is a common remark that people seldom place much value on what they can get for nothing, and Rochester has applied this to sewage sludge. It was offered to near-by fruit growers and truck dargeners without charge, and some used it. But, says Mr. Brown: "Reports of the use of this fertilizer were not enthusiastic. This was, in part, due to a belief that enthusiastic reports would increase the price. In 1919 a charge of 50 cents a load was made, the buyer loading from the dump, and more was drawn away than in the previous year with no charge." At the suggestion of the farmers, an additional 25 cents is charged when the sludge is discharged directly into their carts from a tipple. Up to July 1 of this year the city had received $650 for sludge.

Possibly other cities might find that, by making it more convenient for the farmers to use the sludge, and by making a charge sufficiently high to cause them to think that the city believes the sludge is worth something, the farmers would come to that opinion also.

The entire paper, which is very interesting, will be published in Public Works next week.

Maximum Speed Highway Construction

The description of a notable piece of highway construction and the accompanying editorial in our issue of October 15, abundantly demonstrate the possibility of securing maximum speed of construction in the early stages of a highway contract and the very great additional profit that may be secured by maintaining the maximum speed throughout practically the entire time of operation.

This desideratum is possible of attainment in nearly all contracts that are executed under ordinary conditions without unusual restrictions or physical difficulties. In general, the principal factors likely to expedite or retard the work are engineering, financing, traffic, organization, equipment, materials, schedule, stimulus and interference. Items which have different relative importance on different occasions.

Engineering promotes the rapidity and economy of work when the surveys, designs and specifications, detail plans and blue prints are all complete in advance of the work, and line and grade and special instructions are always ready for the contractor as soon as he needs them.

Financing is satisfactory when the contractor has acceptable surety bonds ready and sufficient resources and cash balance to buy all materials and equipment in ample time to avoid possibilities of delay and to meet the largest possible payrolls, freight charges, and incidental expenses promptly and without difficulty.

The season should be selected so as to allow the work to be commenced and continuously prosecuted under the most favorable weather conditions, when the soil is in good order and delay from flood or storm or interruptions by rain or inclement weather are minimum.

Ample provision should be authorized and carried out in advance for the suspension or by-passing of traffic or, if it must be maintained along the line, for its regulation so as to involve no delay or obstruction to the construction.

The contractor's office and field organization should be complete, with energetic, skilled and thoroughly reliable men in charge of all the different departments, with selected labor trained to do specific or routine work to the best advantage, and with thorough co-ordination throughout, preventing all interference, duplication of work, or lost time. Each man should know in advance what he is to do, how to do it and when to do it.

The equipment should be of standard type of the highest efficiency, simple in design and abundant to keep the entire labor force always busy and to eliminate labor, save time, and secure continuity of work to the utmost degree.

Arrangements should be made in advance for the testing and acceptance of satisfactory materials of all kinds and for their delivery, storage and distribution in a way most advantageous for rapid work and to prevent delay, and loss or damage to the materials.

A complete schedule should be prepared in advance showing the exact time and duration of every operation, the labor, materials and equipment required for it and noted on a chart, and should be kept displayed and posted daily so that the exact condition of the work may be instantly apparent by inspection.

The men may be stimulated to greater speed and efficiency by several methods or a cambination of them. All of them, or certain groups, may be promised a bonus for the completion of the job or a section of it in a given time. They may be given a certain quantity to perform for which a full day's wage will be paid no matter how quickly it is done. They may be paid on the piece-work plan at a certain rate per unit of work accomplished; and competition may be secured by establishing a rivalry between gangs or sections to be either given prizes or honorary badges for first completing their given amount of work.

Delays and reduced speed are sometimes due to disagreements or quarrels with local authorities or residents, or infringement of local ordinances, which should be avoided; or to waiting for permits to close streets or move sewers, water pipes or telegraph lines, all of which should be provided in advance.

A systematic inspection of all equipment and tools and prompt repairs of any damages or renewals of broken equipment are important and should be fully provided for by the supply and repair department.

Inverted Siphons for Sewers

The Boston Society of Civil Engineers in February, 1915, appointed a committee on Inverted Siphons for Sewers, consisting of W. S. Johnson, R. M. Whittet and Prof. Dwight Porter, with instructions to study and report upon methods of design and construction and results of operation of inverted siphons, both those for carrying sewage only and those for storm water. Shortly thereafter a questionnaire was sent out to New England cities and more or less complete information was secured concerning upwards of 90 siphons. Based upon this and upon material found in various engineering publications the number was later increased to 140 siphons.

A discussion of these data was held in April, 1916, by the sanitary section of the society and more data obtained. Unfortunately the chairman, Mr. Johnson, died in October, 1917, and Mr. Whittet, who succeeded him as chairman, died in December, 1918. Apparently the chairmen of this committee, as is the more or less common practice, performd most of the work, and neither had concluded the summarizing of the information The third member, Prof. Porter, succeded as chairman and F. A. Marston and H. E. Holmes were added to the committee. The committee thus constitutd was unable to learn what progress, if any, either of the previous chairmen had made with the report and considerable of the data obtained could not be found. However, the questionnaires were in the possession of the committee and on the basis of these a report has been prepared and was presented to the society under date of July 16th, 1921

This report contains a general discussion of the engineering principles involved in inverted siphons with numerous illustrations of the different points drawn from actual practice; a tabulation of the data obtained through the questionnaire and detailed descriptions of a number of inverted siphons both in Massachusetts and elsewhere An effort is made below to present in as condensed form as possible some of the more valuable features of this report, omitting to a large extent the discussion of fundamental principles, which can be found in text books such as Folwell's "Sewerage," Metcalf & Eddy's "American Sewerage Practice," etc.

Apparently the earliest inverted siphon in this country was one built under Dorchester bay and completed in 1883. In addition to being the oldest it is also conspicuously the longest, largest and deepest inverted siphon in Massachusetts, being 7,160 feet long, 7.5 feet inside diameter and averages 142 feet below low tide. Quite recently a considerably larger one has been built to convey the sewage of New Orleans under the Industrial canal, this being 10 feet in diameter with a nominal carrying capacity of 2,000 cubic feet per second.

Most inverted siphons are under pressure and are generally built of iron or steel, although in some cases vitrified pipe is used, generally reinforced with concrete.

Inverted siphons are used where the hydraulic gradient of a sewer line lies above the bottom of a stream or valley crossed, and also where it would pass through another conduit, subway or other underground structure. A notable illustration of inverted siphons under subways is furnished by New York City, where 20 siphons were necessitated by the construction of the subway, these varying in diameter from a pair of 101-inch pipes to one 16-inch pipe for storm water, and for house sewage from one 6-inch pipe to one 42-inch. Most of the New York siphons are comparatively short, varying in length from 66 feet to 256. The depressions below grade vary from 2.3 feet to 22.0, most of them running between 10 feet and 15 feet. The first New York siphon was built in 110th street in 1913 for carrying a 10-foot by 12-foot sewer under the Lexington avenue subway. Two authorities on sewer construction advised against it, but it was built and has given no trouble. This and another siphon could have been avoided by lowering the subway for eight city blocks or by building a new trunk sewer, but the former would have cost about $1,000,000 and unfavorably affected the location of stations. The new trunk sewer would have cost $1,500,000, while the two siphons cost about $71,000.

There appear to have been few data for checking up the theoretical calculations as to loss of head, velocity, etc., in inverted siphons, but experiments made by the Massachusetts State Board of Health on the Gardner inverted siphon built in 1890 showed actual losses of head, after flushing, varying under two different heads of flow from about 1.9 to about 2.2 times the loss computed for a clean pipe; while seven months later, without again flushing, the loss of head was roughly 3.5 times that computed for a clean pipe. This was a 12-inch iron pipe 1,050 feet long. Under an average velocity of about 0.4 feet per second, flushing had not yet been thought necessary for several years.

Velocities in five Boston inverted siphons were found to vary from 1.19 to 3.49 feet per second. It has generally been assumed that siphons should be so designed and operated as to secure a velocity of at least two or three feet per second, but experience with these and other siphons seems to indicate that lower velocities than these have been maintained for years without causing serious deposits or other troubles. Actual velocities, however, may be increased by deposits in the siphons, as is described further on.

Concerning the profile of an inverted siphon, the committee reports that "where the water carries heavy matter in suspension or rolled along the sewer bottom, as in the case of storm flow, an upward slope at the downstream end is more favorable than a vertical rise for carrying the grit out of the siphon. In cases where there is but scanty head available and its conservance is important for avoiding back water upstream, inclines at the ends involve somewhat less loss of head than vertical wells. Inclines are a feature of all the inverted siphons used on the combined sewers intersected by the New York City subways, with the exception of that at Hudson avenue, Brooklyn."

Screens above siphons are not generally introduced and the advisibility of them is to be questioned. "During the construction of the Brooklyn inverted siphon made necessary for subway work, the use of bar screens above siphon entrances to keep out large floating materials was considered, and to test its practicability a temporary wooden screen was set up in a large sewer leading to one of the siphons. Within two days it was completely covered for the depth of the flow with rags, paper, twine, wood and other debris, effectively blocking the flow and showing conclusively that any such device would form a dam in a very short time." (See "Municipal Journal" for April 26, 1917.)

There appears to be wide difference of practice regarding the employment of sumps at the upper ends of inverted siphons to catch silt and other heavy matter. Of the siphons for which returns were received, sumps were provided on 16, at the upstream end, on 32 at the downstream end, on 17 at both ends, and on 58 at neither end. The first inverted siphon built in New York because of subway construction had a sump at the upstream end, but after seven years of experience with it the engineers considered it unnecessary and recommended omitting sumps from subsequent designs. Instead of a sump, an inverted siphon in Fitchburg, Mass., had placed above it a grit chamber 50 feet long, and the Dorchester bay siphon referred to has a settling chamber in the form of twin "deposit sewers" 1,260 feet long in which the velocity does not exceed one foot per second.

CLEANING INVERTED SIPHONS

For cleaning inverted siphons, both flushing and hand work are employed. For flushing the methods in use are stated by the committee to be as follows: (a) The temporary speeding up of pumps, if there is a pumping station on the sewer line. (b) Receiving the sewage flow at the head of the inverted siphon into flush tanks which automatically discharge when full. (c) Providing a permanent flushing gate at the manhole at the head of the inverted siphon, or else grooves for the insertion of stop planks when desired. (d) Opening a blow-off at the low point of the pressure pipe of the inverted siphon. (e) Admitting clean water at the head of the inverted siphon from a permanent connection made with a street water main or through a hose line from a neighboring hydrant. (f) Introducing river water through a special connection to the chamber at the head of the siphon, which is occasionally possible.

As illustrations of the above methods, method (a) was used in the Dorchester bay inverted siphon. In connection with this, the value of C in the Chezy formula was determined both before and after flushing, using the pumps as meters, and this co-efficient was found to increase from about 80 before flushing to between 140 and 150 after flushing. Increased velocity for flushing was obtained by proper manipulation of the pumping units, admitting sea water to the pump wells when there was not enough sewage and storm water.

Method (b) was used at Concord, Mass., where there was installed a flush tank at the head of each of two 8-inch siphons, one with a capacity of 7,400 gallons and the other 1,570 gallons, the tanks discharging from 10 to 14 times a day.

Method (c) was employed in the siphon of the metropolitan main sewer at Portland and Main streets, Cambridge, and on four siphons on New Bedford.

Method (d) was used for a 30-inch inverted siphon 5,300 feet long at Fitchburg, which drops 52 feet from its upper end to the lowest point in the Nashua river, where there is provided a 24-inch blow-off discharging into the river. At Gardner and at Andover there are blow-offs at the low points discharging onto small filter beds; the former being a 12-inch iron pipe 1,050 feet long with a 25-foot drop and the latter a 12-inch pipe 4,980 feet long with a 66-foot drop.

Method (e) is employed in connection with the Andover siphon just referred to, which is connected with a 6-inch water main. This method is also used for the inverted siphons under the subways in New York City wherever the dry-weather pipe has at times too small a flow to prevent deposits.

(To be continued)

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

Samall Bridge Foundations in Deep Water

When the foundations for small bridge piers are built in water more than 5 or 10 feet deep the construction of submerged concrete or masonry is likely to be more difficult and expensive than where the water is shallower, but unless the current is very swift or there is a very irregular hard bottom the work can usually be done with moderate rapidity and economy when the designs and specifications are properly adapted to the conditions, and even provided they are not, or unexpected conditions develop, good results may often be obtained if the engineers will accept alternative features of design, suited to practical and economical methods of construction, which the contractor may often be in a position to propose.

If the water exceeds 15 or 20 feet in depth or the current is more than 4 miles per hour, or the site is exposed to frequent and violent storms oi the bottom is very difficult, thorough examinations should be made by the contractor before his bid is prepared and he should retain the consulting or supervising services of an engineer experienced in this class of work.

If difficulty is anticipated in carrying out the work according to plans and specifications, very careful study should be given to them and to local conditions with a view of preparing alternate plans and working out standard, modified or special methods of construction to save time, danger and expense. If such methods are found and well presented and the contractor has sufficient equipment and capable men to execute and direct the work it is probable that such changes, if not inimical to the quality of the finished structure will be acceptable to the engineer and owner.

FOUNDATIONS ON HARD BOTTOM

If the bottom is approximately level rock, watertight sectional forms may be sunk to exact required position with their upper edges above water level and a few feet of concrete may be deposited in them under water by bottom dumping buckets or tremies, sealing the form which then acts as a cofferdam and may be pumped out and the remainder of the concrete deposited in the dry.

If the rock bottom is irregular, small cavities may be filled or sloping surfaces built up, by concrete bags deposited by divers around a template to form a support for the lower edges of the form which can then be sunk and concreted, as described above. If the surface of the bottom is generally level, local projections and irregularities are desirable rather than objectionable if they are of sound, hard material and clear the forms. If the bottom is covered with mud, silt or sand it can be removed by dredging, scraping, or by powerful suction pumps aided perhaps by hydraulic jets or by combinations of them. Some of these methods may be employed to remove irregularities and projections of hard strata not solid rock.

After the forms are concreted the detachable sides should be removed and if necessary used over and over again for other piers. If the current is swift, or if wave action has to be resisted, it may be desirable to build timber cribs sunk with rock ballast and having interior pockets for concrete to be deposited under water and form footings, sealing if necessary to lower ends of forms or cofferdams similar to these that have been described.

FLOATING CAISSONS

If the depositing of concrete under water is prohibited or undesirable it may sometimes be placed in a floating caisson, which consists virtually of a sectional, detachable cofferdam large enough to enclose the pier and connected to a permanent detachable bottom, caulked watertight, floated to position and moored over the required center after the river bottom there has been properly leveled by divers or by dredge or scraper work, provided it is of satisfactory hard and sound material.

If the bottom is not too soft to carry the load wooden piles may be driven in it and capped with concrete placed under water or cut off to exact level by a submerged circular saw, or the piles, carefully driven to approximate position, may be left uncut and their tops enclosed in a carefully leveled mass of concrete, thus forming a footing with horizontal surface to receive the bottom of the caisson which is gradually sunk to rest on it by building the concrete pier within. The bottom of the caisson may be either of concrete or of timber, remaining in position after the sides are detached and removed. If of concrete, it should be reinforced like a floor slab, to resist unbalanced upward pressure. It may have short side walls connected by transverse partitions, all forming stiffening webs. Rubber gaskets or their equivalents should be provided in the joints of the detachable sides.

COFFERDAMS

If the rock bottom is covered with several feet of mud, clay or solid earth there may be built on it a cofferdam, consisting of a single line of interlocking steel sheet piles assembled to form a complete enclosure around the pier before driving is commenced, and then driven successively a foot or two each by an air hammer or steam hammer moving around and around the cofferdam until all are driven to the required depth.

Under ordinarily favorable conditions such a small cofferdam can be readily pumped out with one or two 4 or 6-inch centrifugal pumps that will also take care of ordinary leakage through the sides, the latter generally diminishing as the narrow openings of the installation joints become filled with mud and silt, a process which can be accelerated by throwing in sand, manure and similar material on the outside where it will be drawn in by the flow of the water. The cofferdam can be thus unwatered and the bottom excavated to a point not below the lower ends of the piles, after which the forms can be placed and the concrete deposited in the usual manner, and the piles pulled and redriven for other cofferdams or stored or sold.

Steel sheet piles of various sizes weighing from 5 to 50 pounds per square foot have been designed and manufactured for this sort of service and some of them provide for very wide units of minimum weight and cost to be used in soft material while others are intended for hard driving and will endure great abuse. The ordinary weight is from 20 to 45 pounds per square foot and the cost is generally slightly greater than that of structural steel. Under favorable circumstances from 50 to 100 sheet piles can be driven per day with a small steam or air hammer. They are driven much faster with double-acting steam hammers that also can be adapted to pull the piles.

CYLINDER PIERS

Small bridge piers have often been made with a pair of riveted steel cylinders from 4 to 10 feet in diameter, sunk to the required depth, filled with concrete and braced together above the bottom of the river. Sometimes these cylinders are sunk above a small cluster of previously driven piles and sometimes the cylinders are first sunk and the piles afterwards driven in them with followers. The cylinders are usually made of thin steel plates and are sunk by loading and interior excavation; having the upper courses bolted or riveted on as they sink. The cylinder sinking may also be facilitated by a hydraulic jet played around the lower edge, if one is available.

The interior may be excavated by any convenient method such as the suction pump or an excavating bucket or even by hand if the water can be pumped out. When the cylinder is sunk to the required depth if the bottom is sufficiently sealed by stratum which it penetrates, the water can be pumped out and the cylinder filled with concrete placed in the open air, but if it is impossible to at first unwater the cylinder, a foot of concrete may be deposited under water to seal it, after which it is pumped out and the remainder of the concrete placed in the dry.

If riveted steel cylinders are not available, wooden cylinders made with staves banded together, may be used instead, but should be shod with steel or iron to form a cutting edge.

IMPROVISED PILE DRIVER

When wooden piles are required for foundations in inaccessible places where it is difficult or expensive to secure and operate regular pile driver machines, it is often possible to drive the piles in soft ground, not clay, by means of a hydraulic jet of 100 to 200 pounds pressure, delivered through the nozzle attached to a long 2-inch steel pipe with flexible supply connection, that may first be used to dig a hole for the pile, and afterwards loosely attached to the pile and carried down with it while the sinking is assisted by blows on the pile top from a battering ram, or any conveniently improvised hammer.

A serviceable hammer can be made from a short round log of heavy green timber which should run up and down between vertical guides, called "leads," that can be rigidly attached to, or pivoted on, a fixed or movable framework or tower or can be suspended from a derrick boom and held by hand lines or guys. A very light and portable arrangement consists of a vertical mast seated on and braced to a T-shaped horizontal sill frame. A-frames, tripods, breast frames and gantries of various kinds on sliding sills or on wheels or rollers may also be used to support the hammer and leads.

Co-Ordinating the World's Production and Construction

A special committee on construction, Noble Foster Hoggson, New York, chairman, appointed pursuant to the action of the board of directors of the International Chamber of Commerce to study the construction industry, referred the results of their study to the production group for examination and decision as to practical measures which should be taken in order that the International Chamber of Commerce may most effectively take action in the matter and the production group has recommended that the board of directors take the following steps:

A. Appoint a permanent committee to undertake a survey of the construction industry which shall proceed along the lines of collecting and collating and disseminating the vast amount of valuable data which is available and which is at present in the possession of such agencies as the British Societies of Engineering Standards, the Royal Institute of British Architects, the French Ministry of Commerce, the Office de Batiment in Paris, the International Biographical Institute of Brussels, the Advisory Committee of the Federation of Labor, the National Federation of Construction Industries of the United States, the Associated General Contractors of America, and a number of similar agencies operating in different countries.

B. Subject to the availability of funds which can be used for the purpose, provide a necessary staff for carrying on the work above described.

Recent Legal Decisions

SIDEWALKS AND CROSSINGS NOT REQUIRED TO BE PERFECT

The Wisconsin Supreme Court holds, Hollan v. City of Milwaukee, 182 N. W. 978, that many circumstances, such as the topography of the locality, the development of the community, the standard of road construction attained therein, the amount and character of traffic, etc., are to be taken into consideration in determining whether a given condition renders a highway defective. What will render one highway defective will not condemn another. This rule applies to sidewalks in cities as well as country highways. It was held that a slope of seven inches in a cement walk approaching the flagstone part of the walk in an alley in a residential district, on which the plaintiff slipped and fell, was not such a defect as to make the city liable for the plaintiff's injuries. Nor was the fact that one of the cobblestones at the crossing projected above the others from 1⅛ to 2 inches such a defect. The court said: "When cobblestones are used in the construction of alleys or portions of walks, there will necessarily be more variation from a level surface than when brick or cement is used. In planning for the construction of walks over alleys and streets where there are inequalities in the surface, municipal officers may assume that pedestrians will use some care and will seek to avoid dangers which are obvious." Walks and crosswalks are not required to be perfect. It suffices if they are reasonably safe. There may be inequalities, projections, and depressions so slight that municipal authorities may assume that they will not cause injury to persons using ordinary care.

CONTRACTS BETWEEN MUNICIPALITIES AND PUBLIC UTILITIES UNDER OHIO CONSTITUTION

The Ohio Supreme Court holds, Link v. Public Utilities Commission, 131 N. E. 796, that section 4, art. XVIII of the Ohio Constitution is self-executing and no action of the legislature is essential to empower a municipality and a public utility corporation to enter into a valid contract for the product or service of such corporation to be supplied to the municipality and its inhabitants. Such a contract is not subject to review by the Public Utilities Commission.

HOLDER OF PAVING WARRANTS NOT ENTITLED TO PENALTY ON DELINQUENT TAXES

A corporation, holder of certain paving warrants, regularly issued by officers of Oklahoma City against lots benefited by paving, and regularly certified by the city treasurer to the county treasurer with the city taxes, brought an action against the county for interest purported to have been collected by the county treasurer and not paid to the bondholder. The evidence conclusively disclosed that the amount of the warrants and all interest collected thereon was paid to the bondholders, but the taxes were not paid when due and became delinquent, and the county treasurer, when collecting the taxes, added the penalty of 18 per cent, as provided by law. The Oklahoma Supreme Court holds, Board of Commissioners of Oklahoma County v. Close Bros., 198 Pac. 845, that the owner of said warrants is not entitled to any portion of the penalty collected by the county, to supply a deficiency for interest not collected, and it was error for the trial court to render judgment against the county for said warrants.

COUNTY NOT LIABLE FOR DAMAGE CAUSED BY THE SPARKS FROM ROAD BUILDING ENGINE IN ABSENCE OF LEGISLATION

A county is a political subdivision of the state, and as such is not liable to suit, unless there is a law which in terms or by implication so declares. Applying this principle, the Georgia Court of Appeals holds, Mills v. Chatham County, 107 N. E. 628, that a petition alleging that defendant county, by the negligence of its servants in the operation of an engine in the course of duly authorized public road building, sparks were emitted by the engine, which set fire to and burned the plaintiff's house, was subject to general demurrer. Without further legislation, it was held there could be no recovery for the damages occasioned by the alleged negligence of the county's servants. A wrong had been done the plaintiff for which the law provided no remedy.

DUTY OF CITY TO GUARD DANGEROUS EXCAVATIONS THOUGH IMPROVEMENT WORK IS DONE BY CONTRACTOR

The Indiana Appellate Court holds, City of Indianapolis v. Cox, 132 N. E. 8, that if a city and its contractors and subcontractors engage in improving a street where the work contemplated involves grading and filling in such a manner as to render the street unsafe for travel, it is the duty of all three parties, including the city, to see that such dangerous places are properly safeguarded by barricades, lights, and other signal devices, unless the danger is open and obvious without any warning devices, and the city cannot relieve itself of this duty by turning the work over to the contractor.

LIABILITY FOR DAMAGES CAUSED BY BROKEN MAIN

In an action against a city for damage to property from the breaking of a water main in the street in front of the premises, the Massachusetts Supreme Judicial Court holds, Lyons v. City of Lowell, 131 N. E. 860, that the city, in furnishing water to its inhabitants for its own profit, was engaged in an undertaking commercial in character and was liable for its negligent acts. As the city was found by the auditor to have been negligent, and as his findings, by the agreement of the parties to the action, were final, judgment was held properly entered for the plaintiffs. Even if the defendant was careful in the inspection and testing of its water pipes and mains, the fault as found by the auditor was in the original construction—that if proper care had been used when the pipes were laid the break would not have occurred.

NEWS OF THE SOCIETIES

Oct. 31—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Get-together fall meeting. New York City.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION Mechanics' Building, Boston, Mass. Secretary, James F. Morgan Devonshire st., Boston

Nov. 1—CLEVELAND SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Hotel Winton. Secretary, Charles H. Day, Illuminating Co.

Nov. 1—VIRGINIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Fall rally meeting. Secretary, Charles Loeber, R. M. Anderson Co., Richmond.

Nov. 1-4—INDUSTRIAL RELATIONS ASSOCIATIONS OF AMERICA. Waldorf-Astoria Hotel, New York City.

Nov. 2—BUFFALO SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Lafayette Hotel. Secretary, F. B. Hubbard, 146 Arkansas st.

Nov. 2—CENTRAL PENNSYLVANIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Williamsport, Pa. Secretary, Prof. P. P. Henshell, Penn. State College.

Nov. 3—HARTFORD BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Bond Hotel. Secretary, W. D. Halsey, Hartford Steam Boiler Inspection and Insurance Co.

Nov. 4—MINNESOTA SECTION, AMERICAN WATER WORKS ASSOCIATION. Minneapolis, Minn., Secretary, H. A. Whittaker.

Nov. 8—WATERBURY BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce Hall. Secretary, J. R. Putnam, 64 Woodside ave.

Nov. 9—BALTIMORE SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club. Secretary, Prof. A. G. Christie, Johns Hopkins University.

Nov 13-17—AMERICAN CIVIC ASSOCIATION. Chicago, Ill. Headquarters, 905-7 Union Trust bldg., Washington, D. C.

Nov. 14—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with A. I. E. E., A. I. M. E. and A. S. C. E.

Nov. 14—NEW HAVEN BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Mason Laboratory, Yale University. Secretary, Prof. S. W. Dudley, 400 Temple st., New Haven.

Nov. 14—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies bldg., New York City. Sec., G. I. Rhodes, 115 Broadway, New York City.

Nov. 14-16—CITY MANAGERS' ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

Nov. 15-18—ATLANTIC DEEP WATERWAYS ASSOCIATION. Savannah, Ga. Headquarters Real Estate Trust bldg., Philadelphia, Pa.

Nov. 16-18—NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H W. Dodd, 261 Broadway, New York City.

Nov. 17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Society of Naval Architects and Marine Engineers. New York.

Nov. 17-18—SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS. New York

Nov. 17—BRIDGEPORT BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce.

Nov. 17—TOLEDO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Toledo Commerce Club. Secretary, Loring Freed, Atlas Chemical Co.

Nov. 17—WORCESTER SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Worcester section, A. I. E. E. Secretary, Harry M. Latham, Crompton & Knowles Loom Works.

Nov. 21—CHICAGO SECTION, AMERICAN SOCIETY OF MEGHANICAL ENGINEERS. Joint meeting with Western Engineering Society.

Nov. 22—ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Nov. 22—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Adelphia Hotel.

Nov. 25—COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel, Denver. Secretary, William Lester, Vulcan Iron Works.

Nov. 28-29—KANSAS CITY SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Two-day regional meeting. Secretary, Louis Bendit, 517 Finance bldg.

Dec. 1-3—MONTANA IRRIGATION AND DRAINAGE INSTITUTE. Great Falls, Mont.

Dec. 6-9—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 14th annual meeting. Baltimore, Md.

Dec. 22-23—KANSAS ENGINEERING SOCIETY Hutchinson Kan

Jan. 17-20—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

May 15-19—AMERICAN WATER WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

CITY PAVING CONFERENCE

About 150 engineers and others were present, Oct. 20 and 21, at a meeting held under the auspices of the Engineers' Club of Philadelphia with the co-operation of the Society of Municipal Engineers, Philadelphia Section; Department of Public Works, Bureaus of Highways and Surveys of Philadelphia; Civil Engineering Department, University of Pennsylvania; Philadelphia Chamber of Commerce; City of Baltimore Paving Commission; Department of Public Works, Borough of Manhattan, City of New York; Advisory Board on Highway Research, Washington, D. C.

The program included the following papers, some of which were discussed on the floor: "The Structural Design of Pavements, Including Sub-base, Considerations and Economic Depth of Foundations," by A. T. Goldbeck, Engineer of Tests, Bureau of Public Roads, Washington, D. C.

"Preparatory Steps: Extension and Repairs of Surface and Sub-surface Structures," by R. A. MacGregor, Engineer, Department Public Works, Manhattan, New York City.

"Factors Determining Selection of Type," by C. M. Pinckney, Chief Engineer, Dept. Public Works, Manhattan, New York City.

"Relation of City Planning and Zoning to the Selection of Type of Pavement," by Jefferson G. Grinnalds, Secretary, Zoning Commission, Baltimore, Maryland.

"Recent Developments and Recommended Changes in Practice."

"Vitrified Brick," by P. C. Painter, City Manager, Greensboro, N. C.

"Wood Block," by Ellis R. Dutton, Minneapolis, Minn.

"Concrete," by B. H. Wait, Consulting Engineer, New York City.

"Hydrated Lime in Paving Concrete," by Tyrrell B. Shertzer, Construction Engineer, New York City.

"Granite Block" by C. D. Pollock, Consulting Engineer, New York City.

"Asphalt Pavements," by Julius Adler, Philadelphia Pa.

"Design of Bituminous Mixtures," by F. S. Besson, Major Corps of Engineers, U. S. Army, Asst. to Engineer Commissioner, Washington, D. C.

"Native Lake Asphalts and Their Relation to City Paving," by J. S. Miller, Chief Chemist, Barber Asphalt Paving Co.

"Guarantees and Inspection." "Inspection a Remedy for Guarantees," by Prof. S. A. Stephenson, Jr., Associate Professor Civil Engineering, Rutgers College, New Brunswick, N. J.

"Paving Inspection from the Viewpoint of the Contractor," by Thomas S. Martin 3d, representing Associated Genera Contractors of America.

"When Is Repaving Justified?" by Geo. H. Norton, City Engineer, Buffalo, N. Y.

"Regulation of the Disturbance of Old Pavements," by Jacob Schmitt, Chief Engineer of Highways, Brooklyn, N. Y.

"Causes of Destruction of Pavements and Paving Materials," by Dr. Felix Kleeberg, Department of Public Works, Manhattan, New York City.

"Regulation o fthe Disturbance of Pavement," by Col. R. Keith Compton, Consulting Engineer, Bureau of Paving, Baltimore, M. D.

"Repair and Maintenance Problems Affecting City Paving," by P. T. Sharpless, Manager General, Tarvia Department, The Barrett Co.

"Paving Between Tracks and Adjoining Rails: Proper Construction of Street Railway Tracks," by E. J. McIlraith, Engineer of Way, Phila. Rapid Transit Co.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The section meetings of the A. S. M. E. scheduled for October and November contain many features of interest. Chief among these are: 1. The Industrial Fuel Gases meeting of the Metropolitan section held in Newark, N. J., on October 24th, including an inspection trip through the Harrison works of the Crucible Steel Co., dinner at the Downtown Club, and a paper on "Clean Cold Producer Gas from Bituminous Coal," by C F Kaufman of the Crucible Steel Co. of America; (2) the two-day professional session of the Indianapolis section on October 28th and 29th, at which the following papers were presented: "Stopshok Wheels, Their Construction, Use and Results Obtained Therefrom," by B. F. Seymour; "Stellite Metal and Its Application to the Arts," by Elwood Haynes; "Steam as a Motive Power for Commercial Vehicles," by Fred Hamilton; and "Acid Resisting Alloys—Research Work Covering Non-ferrous Metals in Its Application to Their Acid Resisting Properties," by George A. Drysdale; (3) an address at the meeting of the Buffalo section on November 2nd by Prof. Arthur M. Greene, Jr., on "Progress in Mechanical Engineering Research;" (4) one at the Virginia section meeting on November 1st on "The Engineer's Place in Industry:" (5) discussion of the subject "Railroad" at the November 9th meeting of the Baltimore section; (6) the joint conference of the New Haven branch with the New Haven Chamber of Commerce and local sections of engineering societies, which will be a symposium on the economics of the coal problem in Connecticut; (7) an address at the Toledo meeting on November 17th on the "Industrial Engineer in Business," by Clifton B. Reeves of the Willys Overland Company; (8) an address at the meeting of the Atlanta section on the 22nd on "Water Power Developments of the Southeast," by C. G. Adsit; (9) a talk at the Philadelphia section meeting on the same date by Commander H. C. Richardson, U. S. N., on "Experiences on the NC 3 During the Trans-Atlantic Fight;" (10) an address by William Lester of the Vulcan Iron Works on "Properties of Cast Iron and Gray Iron Foundry Methods," before the November 25th meeting of the Colorado section; and (11) the two-day regional meeting of the Kansas City section to be held November 28th and 29th, at which will be discussed "Machinery Methods and Difficulties of Drilling," by R. D. Bush of the Empire Company, El Dorado, Kan.; Ross M. Stuntz, general superintendent of construction, Empire companies, and C. P. Demit and A. L. Bramer of the Gypsy Oil Co. of Tulsa, Okla., "Transportation of Oil by Pipe Lines," by S. B. Severson of the Empire companies, and the oil supply of the world by Mr. Ambrose of the Bureau of Mines, Washington, D. C.

The following section meetings are scheduled for the immediate future: Metropolitan branch, subject, "Engineering Financing;" Bridgeport branch, subject, "Relation of Engineering and Management," discussed by Walter Rautenstrauch of the J. G. White Management Corp., N. Y. C.; Columbus section, at which meeting the section will be hosts of the Associated Columbus Engineering Societies; Atlanta section, get-together dinner; and the Philadelphia section, subject "Public Utilities," address by W. C. L. Eglin of the Philadelphia Electric Co.

AMERICAN SOCIETY FOR STEEL TREATING

A course of lectures has been planned by the American Society for Steel Treating, together with Engineering and Architectural Societies of Minnesota.

These lectures, nine in all, will cover the following subjects:

Composition, Elements and Classification of Steel.

Instruments and Apparatus.

Constitutional Diagrams.

Cast Iron, Malleable Iron and Cost Steel.

Forgings.

Annealing and Hardening.

Drawing and Inspecting.

Alloy Steels.

Tools and Die Steels.

A fee of $1.00 will be charged those enrolling for the course which will cover the entire expense.

For full information address Alexis Caswell, 200 Builders Exchange, Minneapolis.

ENGINEERS' SOCIETY OF ST. PAUL

A regular meeting of the Engineers' Society of St. Paul was held Otober 10. J. P. Kyle, attorney, spoke on "The Proposed City Charter."

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The October meeting of the Minnesota Section of the American Institute of Electrical Engineers was held October 24th at the State University. W. F. G. Swann, professor of physics, University of Minnesota, spoke on the "Theory of Relativity."

JOINT MEETING OF NATIONAL ENGINEERING SOCIETIES

One of the biggest engineering gatherings of the year will be a public meeting on the subject of the St. Lawrence Ship Canal and Power Project to be held in New York City on Monday, November 14. W. L. Saunders is chairman of the committee making elaborate preparations for this event, which is one of a series of joint meetings arranged by the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

Governor Henry J. Allen of Kansas will be one of the speakers. He will discuss the project from the standpoint of the producer of the Middle West. Dr. R. S. McElwee, former Director of the Bureau of Foreign and Domestic Commerce, now Director of the School of Foreign Service, Georgetown University, Washington, D. C., will speak on "The Greatest Single Step along the Road to National Efficiency." Dr. MacElwee will illustrate his talk and will go into the economic features of the project.

H. I. Harriman of Boston will discuss "The Power and Transportation Features of the Project, Translated into the Economics of New England and the East." Definite acceptances have been received from these speakers. Ex-Governor W. L. Harding of Iowa is also expected to deliver an address. Herbert Hoover has been invited to preside.

BROOKLYN ENGINEERS' CLUB

At the regular meeting, October 13th, a paper entitled "Art of Illustration in the Promotion and Publicity of the Ideas, Inventions and Work of Technical Men," and illustrated by lantern slides, was presented by Mr. H. P. Quick, consulting engineer.

DINNER TO JOHN FRITZ MEDAL DEPUTATION

A dinner was given in New York, October 10th, by the American Society of Mechanical Engineers to the deputation, which conferred the John Fritz Medal on Sir Robert Hadfield and Eugene Schneider, which was participated in by a large number of members and guests who listened to a number of interesting addresses in some of which the International Peace Aspect was discussed.

INDUSTRIAL NOTES

Teran-Lange, Inc., contractors, has recently been organized to engage in the installation of power, heating and ventilating plants, with offices in the Grand Central Terminal, New York City.

The Standard Sand and Gravel Co. has been incorporated at Kewanee, Wis., by George Shackett, I. J. Fiddler and Charles L. Peterka of that city.

The Pittman-Smith Engineering Co., Pittsburg, Pa., has recently been organized by E. W. Pittman and H. P. Smith, general manager and chief engineer respectively for the engineering works department of the Dravo Contracting Co., to engage in the design of power plants, machinery layouts and all types of industrial buildings.

CLEVELAND BUILDING EXPOSITION

Cleveland will offer something new in the way of a building exposition opening the new $5,000,000 municipal auditorium January 4 to 14, inclusive. It is sponsored by the Builders Exchange, the largest organization of the kind in the United States, and will be on a non-profit basis. Earnings are to be rebated to the exhibitors, pro rata, according to space they bought.

Nearly six years ago Cleveland material men put on a most successful exclusive building material and equipment show, introducing the rebate idea.

The convention hall and the main exhibition floor will both be used. Already approximately 60 per cent of the space has been sold.

Exterior structural materials, real estate, financing and architecture will dominate the convention or arena floor. Here will be built perhaps a dozen completed cottages and bungalows. On the main exhibition floor will be shown everything that goes inside the building, decorating, finishing, furnishing and equipment, while a section will be set aside for contractors' machinery and equipment.

The lumber interests have engaged a $10,000 space, while two individual brick exhibits will occupy spaces that each cost in excess of $6,000.

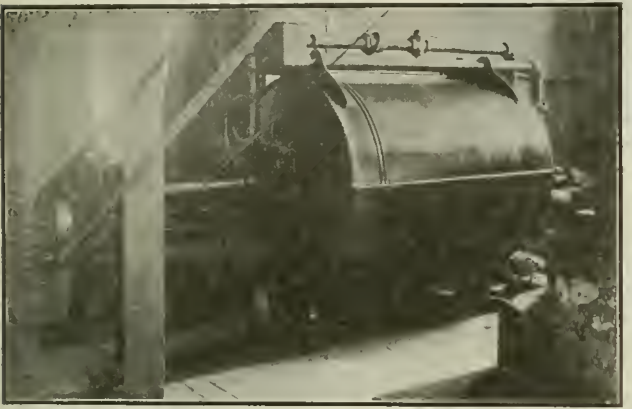
Adding to the national interest The Associated General Contractors will hold their annual convention in Cleveland during exposition week, as also will the National Federation of Construction Industries, while the annual convention of the Ohio Association of Builders Exchanges is scheduled for the last three days. Effort is being made to increase the convention list.

The sole object of the exposition is to stimulate building interest for the coming spring. Last year Cleveland's building investment was a trifle more than $78,000,000. In the Fourth Federal Reserve district, of which Cleveland is the financial center, the building investment was approximately $480,000,000. And there are nearly 100,000 vacant building lots in the hands of prospective builders in Greater Cleveland today, according to the county auditor.

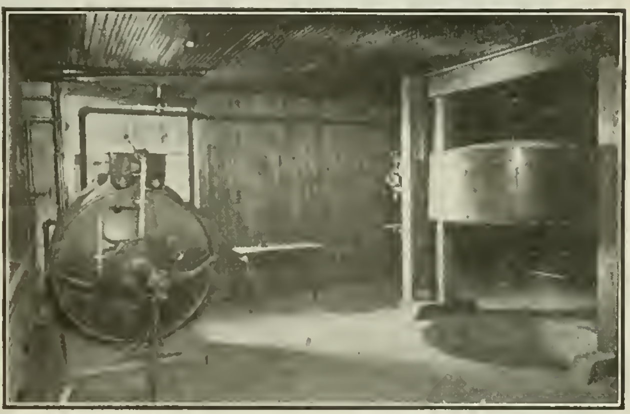
Ralph P. Stoddard, who had charge of the 1916 show, is Director General of the exposition, and Richard G. Collier, who was associated with him then, is assistant manager.

Automatic Gas Making for Towns and Isolated Consumers

In many cases where it is expensive, inconvenient or causes much delay or the installation of costly plant and equipment to provide ordinary coal gas for illumination, heating and cooking purposes, it has been found advantageous to install machines producing gas from gasoline, a high grade naptha which evaporates in the open air. The process of producing the gas is simple, but as the gasoline evaporates irregularly, the air, which is the vehicle by which it is delivered to the burners, contains varying amounts of the gas, which is likely to cause smoke and make it difficult to regulate the flame satisfactorily.



MACHINE WITH CAPACITY OF 120,000 FEET IN 24 HOURS INSTALLED IN CHEMISTRY BUILDING, PENNSYLVANIA COLLEGE



500,000-FOOT MACHINE INSTALLED IN MINING BUILDING, PENNSYLVANIA COLLEGE. AIR PUMP DRIVEN BY WEIGHT.

There was designed several years ago a machine producing gas by evaporation of gasoline at normal temperatures and provided with a special apparatus for delivering variable fixed quantities of gas and pure air to a mixing chamber where an absolutely regular quality of gas of any desired degree of richness can be maintained under uniform pressure and transmitted to the burners.

The machine consists essentially of a carburetor in which the gasoline is volatilized, a mixing chamber by which the required richness of gas is accurately maintained, and a meter or air pump, usually operated by a weight, that provides the air pressure for mixing and delivering the gas and is equipped with a special valve and regulating mechanism essential to the improved features of the machine.

The whole apparatus is small, compact, free from complicated parts or liability to breakage or derangement. It can be installed rapidly by ordinary workmen in any convenient location and will, when properly assembled and adjusted, work automatically without attendants, providing a constant supply of a uniform quality of gas at a uniform pressure and requiring no other attendance than that necessary to occasionally replenish the gasoline supply and wind up the weight.

These machines, called Tirrill Equalizing Gas Machines, have been installed and successfully used in many places for lighting, cooking, heating and power for residences, villages, institutions, shops, factories, laboratories and in educational buildings. The only expense involved is the first cost of installation and the cost of the gasoline, which at the present price of about 25c. per gallon is equal to about $1.00 per thousand cubic feet of gas.

This gas is much hotter than ordinary city gas (coal gas) or acetylene gas. One thousand cubic feet of it will maintain an 80-candle power burner, equipped with a mantle, for 400 hours at a cost of ¼ of one cent or less per hour.

It is claimed to be superior to acetylene gas because of its freedom from explosion, to which the latter is subject, and because it only costs about one-fifth as much. Blau gas or Pintch gas costs from one to three times as much as Tirrill gas and is delivered in bottles which are inconvenient and sometimes dangerous to handle and transport.

When used for cooking, Tirrill gas costs no more than coal and eliminates the cost of kindling wood, labor to build fires, labor for removing ashes, extra space required for the coal apparatus, labor of cleaning chimney, increased insurance rates and increased cost of renewing cooking utensils, which together with the greater convenience and the consumption of the gas only when in actual service makes it very desirable for domestic purposes.

When equipped with a Tirrill Blast Flame heating burner, the gas will produce a temperature of 2,000 degrees, which is instantly adjustable for laboratory or mechanical purposes.

When the gas is passed through a Tirrill combination mixing valve it can be regulated to produce and maintain the required temperatures for hot plates, stills, sterilizers, autoclaves, warming closets, blast furnaces, gas fuel heating appliances, ovens, water heaters and ranges.

The machines are made in eight sizes with rated capacities of from 25 to 1,500 lights. The complete equipment, suitable for a small residence, weighs about 1,000 pounds and can be installed by one man in a few days. The largest machine, suitable for institution or community use, weighs about 11,000 pounds and can be installed by two men with ordinary gas fitters' tools in about two weeks. The smaller size machine requires no special conditions or foundations, but the larger ones should be placed on a concrete base. Wherever electric power is available the hand-wound weight that is ordinarily furnished to operate the air pressure device can be advantageously replaced by a small electric motor.

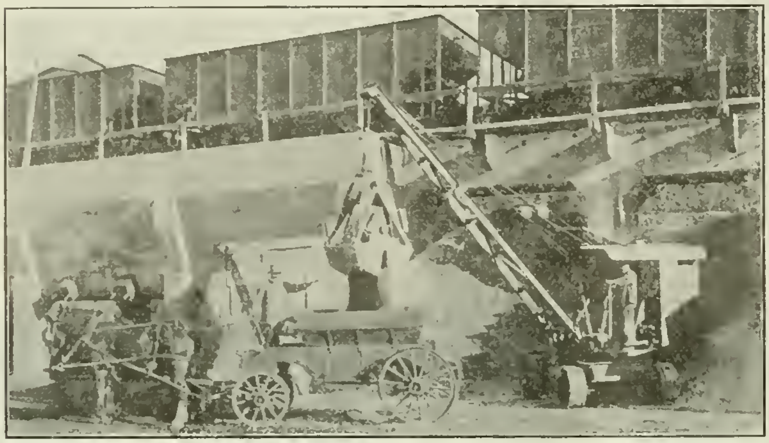
The numerous installations of the Tirrill gas machine include 9 colleges and universities having from 1 to 8 machines each; 8 laboratories, equipped with 1 to 6 machines each; 5 factories with 2 to 9 machines each; 4 shops with 1 to 6 machines each; 6 large hospitals and other institutions with from 1 to 7 machines each; villages and towns, and a large number of private residences having one or more machines with capacities up to 27,000 cubic feet daily. In the Pennsylvania State College, where 8 machines have been successfully installed, it is claimed that the abundant and economical use of the gas for heating and laboratory purposes has been an important factor in the steady growth of the institution from the time the first machine was installed to the present total of 4,572.

The largest machine manufactured is suitable for village supply and has a capacity sufficient to supply illumination and cooking heat for 200 average families, which would then be enabled to save several tons of coal each year by its use.

With the present price of gasoline, considerable advantage is claimed for the installation of these machines in small villages, where the cost of attendance, labor, operation, and supervision can be entirely eliminated by its use. Desirable results can be obtained in many instances where a distribution system installed for natural gas is available and, the natural gas supply having become greatly diminished, it is necessary to provide an artificial gas, which can be much more quickly and easily derived from gasoline than by the construction of a coal gas producing plant.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



A FAST, FLEXIBLE CRANE ON A STEEL WHEEL CHASSIS

A FAST, FLEXIBLE AND PORTABLE CRANE

The Universal Crane, built by the Universal Crane Co., was carefully designed by men of over 20 years experience with the idea of making it extremely flexible and absolutely dependable, and was thoroughly tried out before being put on the market. Its weight has been safely reduced to the point where it can be mounted on motor trucks and rubber tired trailers so that it can be moved quickly from place to place.

The crane is built as a standard unit and can also be mounted on a wide wheel chassis for work on the ground or on standard gage track, or it can be mounted on continuous tread, on a low wheeled traveling carriage that runs on rails laced togther and laid on a railroad flat car, on a portal pier, ground foundation, or barge, and can be transferred from one mounting to another or made to dismount itself under its own power.

Power is furnished by a heavy duty, 4-cylinder, gasoline engine which has been selected for its freedom from vibration and heavy, dependable construction. Electric motor drive can be furnished when required.

The crane is a compact, full-revolving type that requires but little room for storage or to operate in. The rear swinging clearance is only 7½ instead of 9 or 10 feet as is usually the case, and the flat car mounting is arranged so the crane body can be shifted sideways, one foot in either direction, on the axles where it locks so the crane can rotate within 6½ feet from track center.

The crane handles a clam-shell bucket, electric lifting magnet, or hoist block. An electric generator can be added, when necessary, and driven by the crane motor to excite the magnet.

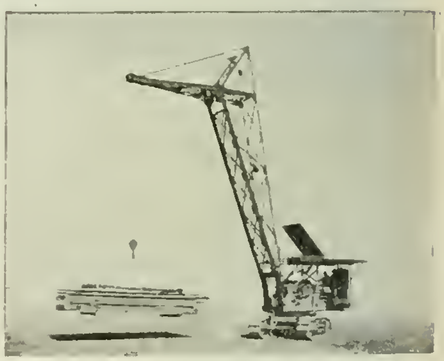
The capacity is 3 to 4 tons and the operating speeds are so high that it can turn out in a day practically the same volume of work as many much larger cranes do, having unloaded 41-yard cars of sand in 28 minutes, and others in around 37 minutes apiece. Stone has been placed in trucks from storage in the quantity of 250 tons in under four hours. Three hundred tons of coal have been taken from railroad cars and placed in trucks in a 9-hour day.

Only one man is required for operation, and he need not be a licensed engineer. The steel wheel chassis and continuous tread types are travelled and steered by power from the operator's platform, and the rubber tired trailer mounting is equipped with a similar travel gear. With the gasoline engine no fuel need be consumed when crane is idle and this machine only uses 10 to 15 gallons a day under normal working conditions.

A FAST AND FLEXIBLE CRANE ON A WHITE TRUCK

GOOSE-NECK BOOM ON P & H CRANE

In adapting a P & H 206 Crane of the type shown in the accompanying illustration, to the handling of loads such as unit packages of lumber from high piles, it was found that the lengths of lumber interfered with the straight or standard crane boom. To overcome this and eliminate much of the costly labor required to handle lengths of lumber, pipe, etc., the makers, Pawling & Harnischfeger Co., developed the Goose-Neck boom, which may be lifted almost straight up without having the load interfere. In other respects this boom is like the standard design and attaches to the gasoline-driven corduroy-traction machine in a similar manner.



P & H GASOLINE DRIVEN CRANE WITH GOOSE NECK BOOM HANDLING 6x18-FOOT 3-TON PACKAGE

The first plant using the Goose-Neck boom on a P & H "206" operated it for handling lumber in aisle-ways 18 feet wide, taking lumber in unit packages off 2 feet piles and placing on wagons or trailers spotted in the aisleways. Hardwood at 4 pounds per square foot was handled at the rate of 1500 square feet per trip. The amount handled per day varied and was limited by the auxiliary equipment—trucks, wagons, trailers—required to carry the lumber to stock, or to the cut-up room or for delivery as the case might be. The company using this "206" crane with new Goose-Neck boom will require only 10 laborers instead of 25 previously used, making a labor saving of $60 per day

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 NOVEMBER 5, 1921 No. 19

Building San Diego's New Water Works

By Allen Henry Wright

Rock carried from quarry to dam by gravity, through crushers, screen, mixer and chutes, a distributing tower being necessary for distributing the concrete in the further and higher parts of the dam.

Of unusual interest, from an engineering standpoint, is the efficient manner in which gravity is utilized in the construction of Barrett dam, on the water impounding system of the city of San Diego, Cal.

The Barrett dam is situated on the Cottonwood river, 36 miles easterly from the city, and the work is being carried on with city forces under the municipality's hydraulic engineer, H. N. Savage, who completed about two years ago the Lower Otay dam, another unit of the city's water system.

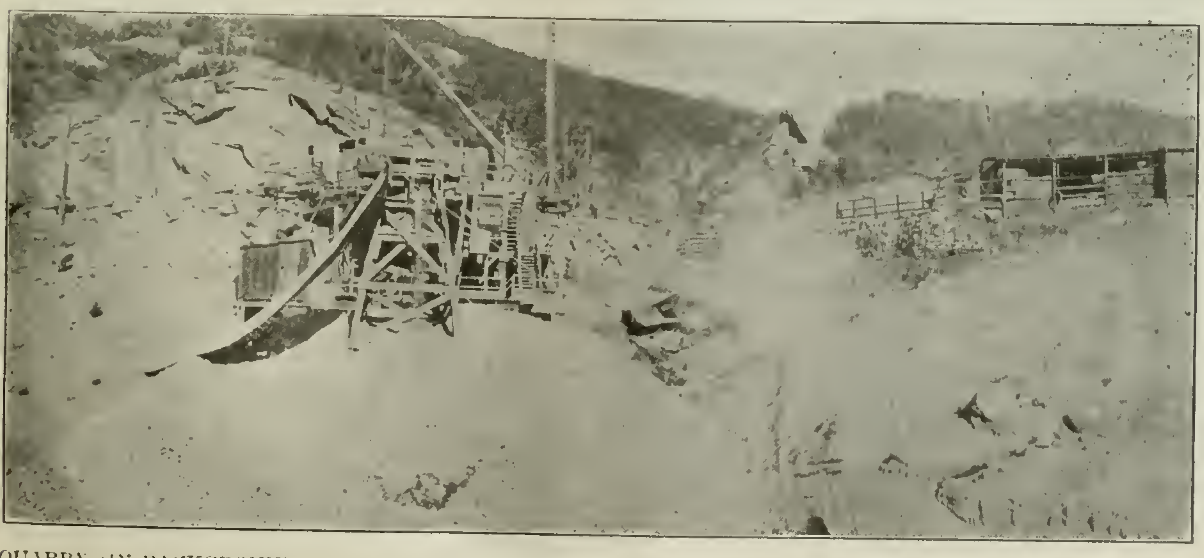
The dam, which will impound 14,000,000,000 gallons of water, was started on February 1, 1920, under a bond issue of $1,000,000, although preliminary work had been under way for two months prior to that. A subsequent bond issue of $500,000 was voted in April last for the completion of the construction.

It is the estimate of the hydraulic engineer that the dam will contain approximately 136,000 cubic yards of concrete masonry, having a weight of 287,000 tons.

The placing of concrete began July 15, 1920, following the clearing of the dam site of all loose and unsuitable material down to solid granite bedrock, the rock and earth excavation for the foundation and abutments of the dam aggregating 66,000 cubic yards. The cement required for the entire job will be about 130,000 barrels.

It is the purpose of this article, however, to deal particularly with the utilization of gravity upon this project.

The Cottonwood river, at the dam site, runs through a narrow gorge, with high, rocky canyon walls, and it is from a point high above the work that the engineer opened up a quarry to furnish the rock for the masonry. He states that the Barrett project is being carried on under the



QUARRY (IN BACKGROUND), CRUSHER BUILDING, DISCHARGE END OF CONVEYOR AND PILE OF BROKEN STONE (IN FOREGROUND) best quarry conditions he has known. The material secured is a perfect, typical granite of medium grain and medium hardness.

When the quarry was first opened it was found that the surface rock was somewhat decomposed and hence not usable. After this class of material had been quarried and spilled over the canyon sides below the dam site, drillers were set at work preparing for the powdermen. For the big blasts, a battery of six 6-inch diameter holes, spaced about 20-foot centers, were drilled from 100 to 150 feet deep in the rock wall, filled with 40 per cent bag powder, and set off, the big blasts throwing down about 25,000 cubic yards of rock.

The rock thus obtained by blasting is broken up at the quarry by smaller blasts and by hammer into sizes up to 16 by 24 inches, not to exceed 4 feet in length, and hauled by one-horse two-wheeled carts, carrying detachable skips of a capacity of 1½ cubic yards, to the crusher, which is located 400 feet above the construction work.

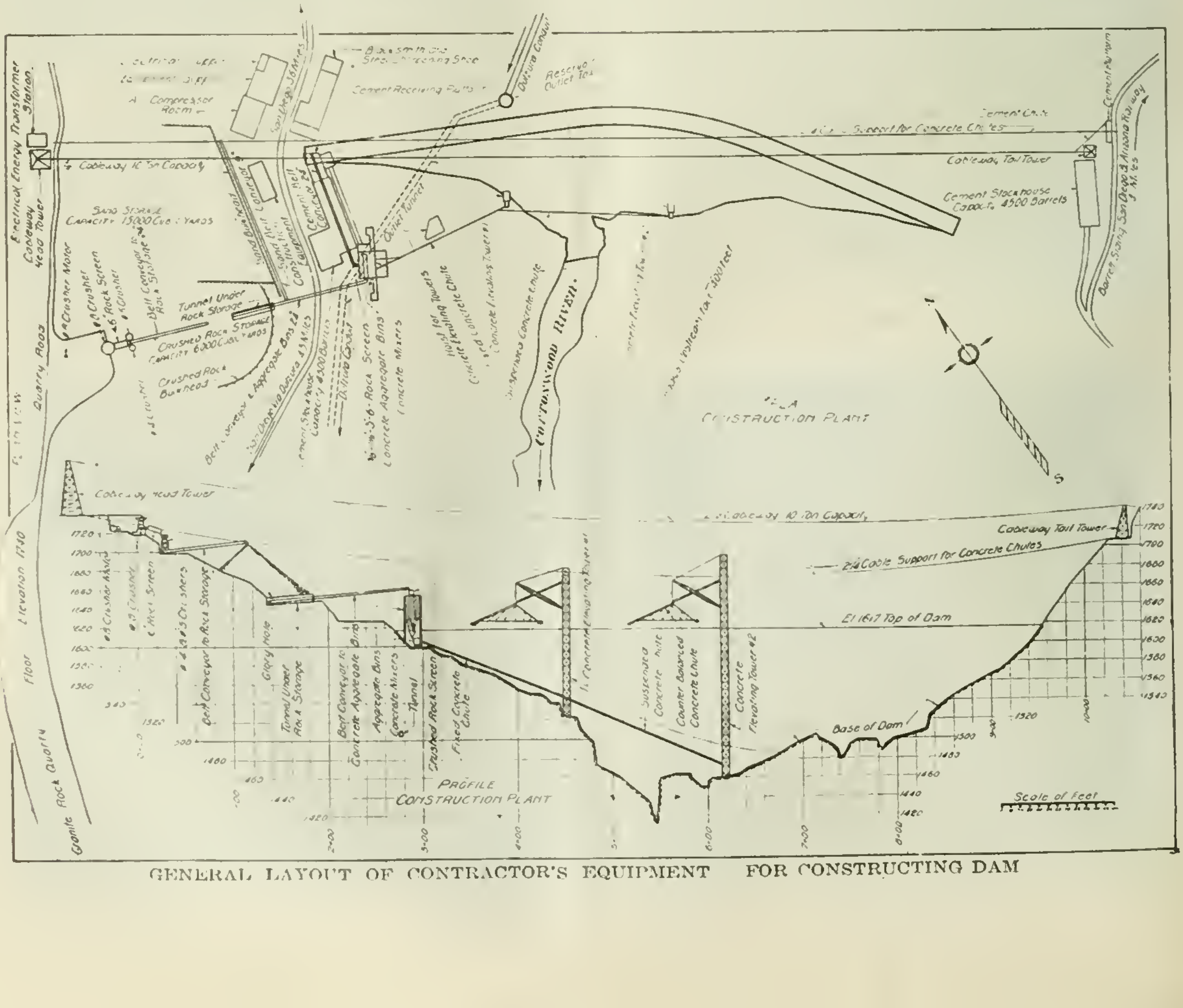
The crusher is of the gyratory type, an Austin No. 8, with manganese steel mantle and concaves of the same material. Up to October 1 this crusher had handled over 90,000 cubic yards of rock without a break. To lay and conserve the rock-dust, a water-spray is played on the rock as it enters the crusher.

After passing through the crusher, the rock goes down to a set of screens where the material is separated into various sizes, from sand up to anything that will pass through a 6-inch screen, even though its longest dimension may run to 14 inches.

Rock pieces of larger size are automatically passed by gravity to a secondary, No. 4, crusher, Gates type, also gyratory, and after being broken into smaller sizes the material is carried out by conveyor belt to the rock stock pile, where it feeds, through the "glory-hole," to another conveyor which carries the crushed rock to the top of the mixer bin, where, in their proper proportions, the ingredients pass into a Milwaukee mixer, with a capacity of 81 cubic feet dry mix.

Again gravity enters into the work, as it has from the start at the quarry, and the mixed concrete flows through a metal-lined chute directly to its final place in the base of the dam, or to the hoisting towers where the buckets are raised to any desired height, according to the progress of the work, and then dumped into adjustable metal chutes, from which the concrete can be deposited as desired in the higher portions of the dam, the material feeding from the chutes by gravity.

Practically one-half of the sand used on the job is obtained in the process of rock crushing, the remainder of the sand being taken from a stock-pile which had been hauled from the stream-bed above the dam in the early stages of the work on the project. In order to conserve the sand and crusher dust as the material passes down from the first crushed-rock conveyor, canvas screens are so placed as to retain all of the finer material,



GENERAL LAYOUT OF CONTRACTOR'S EQUIPMENT FOR CONSTRUCTING DAM

FACE OF QUARRY FROM WHICH CONCRETE STONE IS OBTAINED

which might otherwise be blown away down the canyon.

Water for the construction work and the camp is obtained from the Cottonwood river, and so, with the rock and sand right at hand, the only element entering into the material used in the dam which has to be brought in is the cement, and this is hauled, over specially constructed roads, from a siding on the San Diego and Arizona railroad, 14 miles distant.

In preparing the camp site for the work, it was necessary to construct two cement stock-houses, each of a capacity of 9,000 barrels; a blacksmith shop; two spouting towers of 160 and 182 feet, respectively; a warehouse; recreation building, offices, five bunk-houses, 25 cottages for married employees, and other features. The camp has a telephone system, domestic water supply, a septic-tank sewer system and a high-pressure fire protection.

About 175 men are employed on the project, and the average amount of masonry placed for each 8-hour shift, with a single mixer, is 280 cubic yards, with a record amount of 387 cubic yards for a single shift.

Electricity is used for power in all stages of the work, from the generation of the compressed air for the quarry drilling down to the hoists on the dam, but wherever gravity can be utilized in the moving of material it is so employed, and in this way the cost of the construction is greatly reduced. Engineer Savage reports that the cost per cubic yard of material placed is $6, this including the cost of cement and all plant daily operation and overhead.

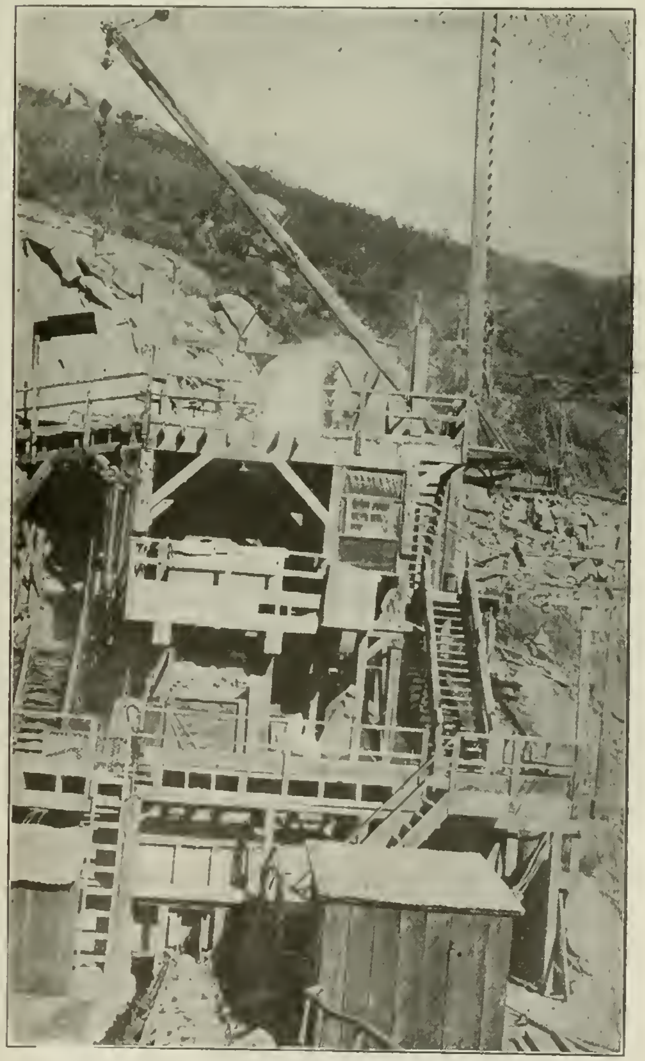
Sanitary Engineering Inspections of the Health Institute

In connection with the Health Institute to be held in New York during November, as previously announced in Public Works, a program has been drawn up for inspections to be made by the Sanitary Engineering section, the chairman of which is Kenneth Allen, of the New York City Board of Estimate and Apportionment, the other members of the committee including M. N. Baker, George W. Fuller, George T. Hammond, F. E. Hale and Charles V. Craster.

On November 8 there will be an inspection of the Newark hog farm under the courtesy of J. W. Costello, chief of the Bureau of Highways of Newark. After returning from this there will be symposiums at the American Museum of Natural History on garbage disposal and on harbor pollution.

On November 9 there will be an inspection of the Mt. Prospect laboratory of the Bureau of Water Supply of New York, which is located in Brooklyn, this being by the courtesy of Col. Merritt H. Smith, chief engineer of the bureau. In the afternoon there will be an inspection of the Kensico dam with its chlorination and aeration plants, this also by the courtesy of Col. Smith. From here a limited number will be taken by automobile, through the courtesy of W. W. Brush, deputy chief engineer of the bureau, to the Mt. Kisco sewage disposal plant.

On November 10 there will be in the morning an inspection of the Little Falls filtration plant by the courtesy of A. W. Cuddeback, superintendent and engineer of the Passaic Water Co., and



ROCK CRUSHER, VIEWED FROM STONE PILE
At the bottom is seen the belt conveyor removing stone from the lower crusher to the stone pile

from here to Wanaque, where the dam foundations will be inspected through the courtesy of Arthur H. Pratt, chief engineer of the North Jersey District Water Supply Commission. At this dam a light lunch will be served by the contractor, Walter H. Gahagan.

On November 11 the morning will be devoted to an inspection of the Dyckman street sewage screening plant by courtesy of W. E. Duy, engineer in charge of maintenance. In the afternoon there will be an inspection of the East 139th street refuse dump and an exhibit of the street cleaning apparatus at the East 24th street yard, through the courtesy of John P. Leo, commissioner of street cleaning.

Portland Cement Output

The shipments of Portland cement during July, August and September of this year reached approximately 33,970,000 barrels, establishing a record for this quarter. The amount produced in September also established a record for that month, being 10,027,000 barrels of finished cement. These figures, which were prepared under the direction of Ernest F. Burchard, of the United States Geological Survey, when considered in connection with the low demand for other commodities, showed a remarkable demand for cement.

About 20 per cent of the output is now going into the construction of concrete roads, which is a large increase over former periods. In addition, the revival of building activity is under way probably to a greater extent than is generally realized. Aside from the highway work, the larger part of the cement is being used on small to moderate sized jobs, as few large engineering projects are under way.

Wholesale prices of Portland cement per barrel, without bags, in carload lots, ranged as follows during September, the lower quotation in each case being that for the last few days of the month. At New York $2.69 to $2.75; at Chicago $1.97 to $2.17; at Minneapolis, $2.26 to $2.41; at Denver, $3.10; at San Francisco, $2.89 to $3.09; at Seattle, $3.10; at Atlanta, $2.69 to $2.75; at Dallas, $2.80; at Montreal, $3.10.

American Society for Municipal Improvements

Doings of and at the twenty-seventh annual convention. Reports of committees, papers on paving, sewerage, water supply and other phases of municipal public work.

The twenty-seventh annual convention of this society at Baltimore last week was attended by an unusually large number of members, there having registered 162 active members, 78 associate and affiliated, and 279 guests, a total of 519. Three hundred had registered when the convention was called to order on Tuesday morning. Notable was the presence of fourteen past-presidents.

Several score were present at the sectional meetings of the General Specifications Committees on Monday to discuss specifications. Especially animated was the discussion of the brick specifications, the subject of plain and lug wire-cut brick occupying much of the time; also the sewer specifications, where classification and measurement of material excavated in trenches and other proposed changes were discussed. These discussions in committee were continued Tuesday morning. Some of the committee members had arrived the week previous and held meetings on Saturday and Sunday.

The convention held regular sessions for the discussion of papers on Tuesday afternoon, Wednesday morning and evening, Thursday morning and afternoon, and Friday morning. Tuesday evening the Baltimore Country Club gave a reception and dance to the society members and guests. Wednesday afternoon was spent in a boat ride and inspection of the harbor. On Thursday evening they were entertained by the Press Club at the Lyric Theatre, where was given an entertainment that included vaudeville, and addresses by Senator King, of Utah, and Philips Lee Goldsborough, former governor of Maryland.

The convention proper closed on Friday noon, although quite a number remained to take an automobile trip around Baltimore and its public works.

NEW OFFICERS AND PLACE OF MEETING

The officers elected for the coming year were as follows:

President—E. S. Rankin, of Newark, N. J.

First Vice-President—W. W. Horner, of St. Louis, Mo.

Second Vice-President—Ellis R. Dutton, of Minneapolis.

Third Vice-President—H. H. Smith, of New York.

Secretary—Chas. Carrol Brown, of St. Petersburg, Fla.

Treasurer—Linn White, of Chicago.

Finance Committee—E. L. Dalton, of Dallas; S. C. Corson, of Norristown, Pa.; and Joshua Atwood, of Boston.

Cleveland was chosen as the next place of meeting.

Some of the members from Texas and other distant points left for home on Thursday in order to reach there before the threatened strike could interfere.

Secretary Brown, whose home is at St. Petersburg, Fla., was asked, but what is said to be the first message to leave that stricken city, to return there to aid in immediate repair of the damage done by the storm. He left on Wednesday and his duties on Thursday and Friday were taken over by A. Prescott Folwell, editor of Public Works, who had been Mr. Brown's predecessor as secretary.

RESOLUTIONS

Two general resolutions were introduced through the Resolutions Committee, one by which the society heartily endorsed the aims of the Conference on Armament Limitation, expressing earnest hope that the results which it is desired to obtain by this conference be realized; the other instructing the Committee on Sewerage and Sanitation to give special consideration during the coming year to the subject of the ultilization of sludge as a fertilizer and to urge the secretary of the Department of Agriculture to investigate, through the Bureau of Soils, the practicability and methods of utilizing sewage sludge as a fertilizer. It is understood that the American Public Health Association, at its annual meeting in New York in November, will be asked to take similar action.

The program was an unusually full one, more than 70 reports and papers being scheduled for the six sessions, but it was carried through with very few changes and only once was it found impossible to keep up to the schedule. The crowded condition of the program, however, had much to do with shutting off discussion, of which there was practically none in the convention proper, although considerable had been held previously in connection with the paving and sewerage specifications at the public hearings given by the committees having charge of the several specifications.

EXHIBITS

There were as usual a considerable number of exhibits, totaling 37 in number. The greater part of these were arranged in booths around the convention hall and it therefore was imperative either that no use be made of the booths while the convention was in session, or that the meetings be subject to great annoyance from conversation in the booths. It is to the great credit of the exhibitors that no annoyance whatever was created by them; but because of this they derived practically no benefit from their exhibits, since the convention was in session practically the entire time; in fact, some of the booths were not even visited during the entire convention by those who leased the spaces. This was a hardship to the exhibitors which would seem to be uncalled for and it is to be hoped that in future conventions the combining of exhibits and meetings in the same room will not be considered.

During Thursday there was a gathering in Baltimore of the mayors of a number of cities, at the invitation of Mayor Breuning, who organized a permanent body to be known as the "Annual Conference of American Mayors." At the request of this organization, a committee from it and from the A. S. M. I. will consider, during the coming year, a proposition for the holding annually hereafter of concurrent conventions of the two organizations, with probably one joint meeting.

NARRATIVE OF THE CONVENTION

TUESDAY'S SESSIONS

Mayor W. F. Breuning, in his address of welcome, after calling attention to the wonderful progress made by Baltimore since the fire in carrying out a program calling for more than $100,000,000 of municipal funds, emphasized the importance of its efforts to minimize unemployment. Last year a municipal emergency bureau was created in anticipation of the present condition, and plans prepared for emergency employment of labor on public work that, while needed, was not pressing. On this work 30 cents an hour is paid, while 45 cents is paid to those on the regular payroll; the aim being to retain on emergency work none who could find public or private work at higher wages, many of them not being able to really earn even 30 cents.

Major Whitman then outlined what the local convention committee had prepared for the entertainment of the convention. Vice-President Rankin replied in a brief and happy speech to the mayor's welcome, and Col. Compton delivered the president's annual address, in which he expressed the hope that the society would take some action looking to a relief of the unemployment.

Secretary's Report

The secretary read his report, showing a net gain in membership of 36 during the year, and a reduction of the society's deficit by $1,130. The report showed that the membership during the year ending October 1, 1921, changed as follows:

Active: net increase from 457 to 483, there having been 106 added and 80 lost.

Affiliated: net increase from 24 to 35, there having been 15 added and 4 lost.

Associate: net increase from 130 to 130, there having been 30 added and 30 lost.

Total: net increase from 611 to 648, there having been 151 added and 114 lost.

The receipts during the year comprised $2,384,75 as dues from active members, $242.50 as dues from affiliated members, $932.50 as dues from associate members, $301.47 from sale of Proceedings, $19.01 from sale of specifications, $618.27 from advertisements and $1,057.50 miscellaneous; a total of $5,556. There were also received $97.77 interest on Liberty Bonds and bank interest and $49.13 received from the previous treasurer. The large "miscellaneous" item included $800 donated to the society by the local committee of the St. Louis convention, being the balance in its hands after the convention, and $200 was a rebate on the printer's bill which had already been paid. About $50 was contributed by the authors of papers to pay for the cuts used in illustrating them. The society also has an investment of $1,500 in Liberty Bonds.

A year ago there was a deficit of $1,630, and this had been reduced to $500 on October 1, and enough has since been received to more than wipe this out.

About $500 was paid before October 1 on the dues for 1922, and thus will diminish next year's income by this amount; but the dues for that year have been increased to $7.50 and the increase should more than make up for this.

The Executive Committee voted to use the $800 received from the St. Louis committee as an endowment, the interest to pay the dues for five municipal delegates to the society representing that city.

The expenditures included $1,014.66 for office and miscellaneous, $600 for secretary's salary for two years, $401.31 convention expenses, $3,096.50 for printing Proceedings (40 per cent of this for those of the previous year), $121.25 for letter ballot, $78 for committee expenses and $5 Clearing House expenses—a total of $5,316.72.

Committees were then elected as follows:

On Nominations—Fred Giddings, E. A. Kingsley, G. W. Tillson, W. A. Howell, C. Arthur Poole. On Place of Meeting—W. A. Howell, H. H. Smith, E. L. Dalton, T. C. Hatton and Albert Bastis. On Resolutions—A. P. Folwell, E. A. Fisher, H. C. Allen, W. W. Horner, J. W. Hackney.

In the afternoon three excellent papers on street lighting, illustrated by lantern slides, were read, in addition to the report of the Committee on Street Lighting, which, having been printed in the advance papers, was read by title. E. A. Anderson, of the Engineering Dept. of the National Lamp Works, discussing the subject of "Street Lighting and Public Safety," cited instances where increasing the brilliancy of lighting of cities had reduced the number of crimes and also of street accidents, and produced figures to show that a large percentage of street accidents occurred at night.

"Statistics gathered from 32 cities," declared Mr. Anderson, "shows that 31,000 accidents occurred last year. Of these about 9,000 occurred after nightfall. Investigations revealed the fact that 17.6 per cent of these night accidents were caused by insufficient illumination. There were 567 persons killed in these accidents.

"In these 9,000 accidents there was a loss of $54,000,000, whereas the cities in which they occurred spend only $50,000,000 annually for street illumination."

Mr. Anderson said the cities are spending little more now per capita for street illumination than they did a number of years ago.

C. A. B. Halvarson, Jr., of the General Electric Co., gave facts, figures and illustrations relative to the development of street lighting units from the first open arc lamp to the latest type of incandescent, and special lamps designed for highway lighting.

L. A. S. Wood, manager of the Illuminating Section of the Westinghouse Electrical & Manufacturing Co., dealt in his paper with "Ornamental Street Lighting." The poles and lamps should appear well by day. For the former, cast iron was more durable than either steel or concrete and more subject to ornamental treatment. Concrete unless made very heavy, was apt to crack and check, and was chipped by occasional accidental blows.

Charles F. Goob, chief engineer of the Electrical Commission of Baltimore, described the electrical conduit system of that city, which was the first municipal system to be constructed and is now the largest in the world. It contains the wires of 19 paying and 4 free services, and the rentals pay 7 per cent on the cost after deducting interest and sinking fund charges.

D. J. Sweeney, city clerk of Buffalo, N. Y., and chairman of the Committee on Public Markets, presented the report of that committee in abstract. The committee found only one city actually selling food at a municipal stall, and comparatively no farmers using municipal markets. Moreover, prices were seldom lower and often higher than in the regular food stores, the attraction to buyers being the assembly of all foods in one place; and the food was in a less sanitary condition than in stores because more exposed to dust. Under present conditions there seemed to be little to recommend public markets.

Nicholas S. Hill, as chairman of the Committee on Water Works and Water Supply, read a report that constituted a remarkably complete summing up of the recent trend in water works matter in all branches—pumps, purification, rates, etc. An abstract of this report will appear in PUBLIC WORKS in a week or two.

WEDNESDAY'S SESSION

At the morning session, two papers were read, illustrated by lantern slides, describing the water works of Baltimore; J. W. Armstrong dealing with the securing and purifying of the supply and V. Bernard Siems with the pumping stations and distribution system, preceded by a history of the city water works for 125 years. The watershed is now being planted to white pine and spruce. The yield of the watershed has been known to fall to about fifty million gallons a day, while the consumption is about ninety million, and a considerable increase in storage is necessary, which is being obtained by raising the Loch Raven dam 52 feet higher. Other changes will be made and plans are under way for enlarging the filtration plant.

The various pumping plants are being changed over to electric, only two steam plants remaining. In the large areas absorbed into the greater city the water was formerly supplied by private companies, some of which have been bought up but ten private companies still supply about 75,000 of the population.

Spurred on by threatened water shortage, the city has been conducting a waste reduction campaign. A Pitometer survey was begun in July, 1920, and the leakage stopped by this means has totaled already about six million gallons a day, at a total cost for the survey and for repairs of valves, leaks, etc., of $20,000. Meantime a house to house survey has been carried on, by which means a waste of five million gallons a day has been found and stopped.

Mr. Siems also described the use of appliances in construction and maintenance of the distribution system, of which the readers of PUBLIC WORKS were informed in the issue of July 16.

Following these papers, T. Chalkley Hatton read the report of the Committee on Sewerage and Sanitation, of which he was chairman, summarizing briefly the subject matter of the papers prepared for that committee by Langdon Pearse, on

"Organization of Metropolitan Districts," Kenneth Allen on "The Sanitary Condition of New York Harbor," and John F. Skinner on "Sewage Disposal for Small Municipalities." In the first of these, Mr. Pearse has collected references to numerous laws, procedures and organization methods that will be of great value to any who may undertake the organization of a metropolitan sewerage, water, lighting, etc., district. (Abstracts of the papers by Messrs. Allen and Skinner and of one on "Dewatering of Sewage Sludge" by Mr. Hatton, will be published in Public Works.) Following this, a paper on "Sludge Handling at the Rochester Sewage Disposal Plant" was read by N. Adelbert Brown. (This paper is published in this issue.) Papers on "Public Comfort Stations," by H. F. Bascom, and "Retention of Portion of Estimates on Contract Work," by E. S. Rankin, were read by title, having been published in the advance papers.

In connection with his report, Mr. Hatton submitted a resolution as follows:

> Whereas, The rapid increase of sewage disposal plants in the United States is bringing to the attention of municipal officers the desirability of more economic and sanitary methods for disposing of the sludges produced from these plants; and
>
> Whereas, Recent developments in the art indicate that the problem may be best solved in many cases by the conservation and utilization of the fertilizing values contained in sewage sludges and
>
> Whereas, There is no one municipality properly equipped to make a general study of this problem, which is essentially a service for which the Federal Government is especially equipped to perform; therefore be it
>
> Resolved, That the general committee on Sewerage and Sanitation of this Society be requested to make special efforts, during the coming year, to collect and compile detail statistics relating to the production and disposal of sewage sludges within the United States and Canada; and, on behalf of this Society to bring to the attention of the Secretary of Agriculture of the United States the problem of sludge disposal, requesting his co-operation in making prompt and exhaustive investigations of the possibility of conserving and making available to the agricultural interests the fertilizing values contained in sewage sludges produced from all sewage disposal processes established in the United States

This was later reported favorably by the resolutions committee, and was adopted by the society.

(To be continued)

Medical Society Meets in Sewage Plant

The Medical Society of Northampton county, Pa., chose an unusual place of meeting for its regular monthly meeting of October 18, which was held in the sewage disposal plant at Allentown, Pa., the plant which was described in our issue of October 8. An inspection of the disposal plant was one of the features of this meeting, although the discussion of the meeting was on the subject of "Hysteria," which would appear to be in no way connected with the subject of sewage disposal.

Designers of Sherman Island Dam

The attention of Public Works has been called to the fact that the engineering staff of the International Paper Co. should have been mentioned as the designers of the Sherman island dam development which was described in the issue of Public Works for October 22. We take pleasure in publishing this supplementary note in order to give these engineers the credit due them.

Sludge Handing at Rochester*

By N. Adelbert Brown†

Imhoff tank sludge dried on beds and sold to farmers. Details of operation.

The sludge beds at the Rochester plants were designed on the generally accepted rule of one square foot to three persons, and under the local climatic conditions this area has proven satisfactory. The Irondequoit plant handles combined sewage. The ten Imhoff tanks are preceded by grit chambers and Reinsch-Wurl screens and are designed to serve 200,000 persons. There are 40 individual beds, each approximately 44 feet square. The tanks are built in double units with a common sludge trough. This trough is on the wall between two rows of four beds, allowing the sludge from any tank to be diverted to one of eight beds. The troughs have a slope of one in fifty, which gives a high velocity and are nearly self-cleansing. The sludge is discharged onto the center of the bed through an 18-inch opening controlled by stop boards in the side of the trough. The sludge falls onto a concrete splash plate. A depressed channel extends transversely to the sludge troughs between the first and second and the third and fourth beds of each tier. This channel is four feet below the top of the bed and nine feet deep and nine feet wide. In this channel is laid a narrow-gauge track for the sludge cars and on the walls are tracks for a gantry crane.

The beds are level and consist of 2 inches of fine sand, 3 inches of coarse sand, 8 inches of gravel and 6 inches of broken stone. They are under-drained by 3-inch farm tile laid with open joints on 8-foot centers. These tile discharge into an open drain under the track channels.

The Imhoff tanks have two rings of perforated pipe in each hopper and the sludge is agitated each week. The sludge pipes are also blown out and left filled with clear water after each drawing. No cones are found in the sludge surface and no plugging of the pipes has been experienced.

Drawings are made during the season as often as the removal of the dried sludge permits. Nine inches of wet sludge are drawn on a bed. The drawing season is reasonably constant as shown by the following table:

Year	First Drawing	Last Drawing	Period in Days
1919	April 29th	December 10th	225
1920	May 7th	December 21st	228
1918	April 15th	November 15th	214
1921	March 24th		

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*Paper before the American Society for Municipal Improvements.

†Engineer in charge of sewage disposal, Rochester, N. Y.

While the season is nearly the same each year the number of drawings varies according to the weather. In 1920, each bed received nine fillings, an average of one every twenty-five days. In 1921, an extreme drought permitted seven drawings between March 24 and June 23, an average of one every 13 days with the longest drying period 22 days and the shortest 10 days. Up to August 10, four additional drawings have been made, which gives a season's average to date of 12.6 days per bed.

To remove the dried sludge, two trains of six 1½-yard Koppel cars are used. The trains are run in the depressed channel under the gantry crane, which lifts the car bodies from the trucks and sets them on the bed and replaces filled bodies on the trucks. In loading cars, stone forks are used and the sludge lifted in cakes approximately 12 inches square. A few extra car bodies set on the beds permit the moving of trains without delaying the labor force. The trains are hauled by storage battery locomotives and the crane is electrically operated, as power is developed at this plant from the effluent.

The usual force consists of one foreman, one hoist man, two locomotive runners and eleven laborers. Eight men do the loading, one is on each train to dump the cars and one is at the dump to keep the track clear. This crew will remove on an average two hundred cubic yards of loose dry sludge in eight hours. With labor at 50 and 55 cents and neglecting power costs, this sludge is delivered to the spoil bank at 33 cents per cubic yard.

During much of the season the sludge is sold to farmers as removed from the beds. The cars are run to the tipple and dumped directly into the wagons or trucks. As the tipple is located further from the beds the additional haul and delays in dumping increase the cost of removal 10 per cent.

The sludge when drawn contains from 79 to 86 per cent of moisture. It is more dense in the first drawings each season and is thinner as the season progresses. At the time of removal the moisture is reduced to from 50 to 60 per cent. A rain on the beds after the cracking has occurred packs the sludge so that it is difficult to reduce the moisture below 60 per cent in any reasonable time. The shrinkage in drying is normally a little more than half of the wet volume. Analysis of a dry sample yields 2.2 per cent nitrogen and 56.3 per cent mineral matter.

Due to the depth of the tanks, the entrained air bubbles expand greatly when drawn onto the bed and make the dried sludge a light, porous cake.

The quantity of sludge varies, but the average for three years has been 1.51 cubic yards of wet sludge per million gallons. In a large plant the disposition of the dry sludge becomes a problem. Realizing this, the plant at Rochester started in 1918 to develop a demand for it as a fertilizer. During that time it was given to any farmer who would load and draw it away. The plant is located in a fruit and truck garden section having a sandy loam soil. Reports of the use of this fertilizer were not enthusiastic. This was in part due to a belief that enthusiastic reports would increase the price. In 1919 a charge of 50 cents a load was made, the buyer loading from the dump, and more was drawn away than in the previous year with no charge. A proposal came from the farmers that with a more convenient method of loading they would pay a higher price. The tipple was erected and the price put at 75 cents per car, the car holding nearly two cubic yards. When sludge is not being removed, the dump is still open at 50 cents per yard. During 1920 the income from this source was $1,015. To July 1 of this year it has been $650. The income is small but the disposal of continually increasing quantities is preventing an accumulation on the grounds of the plant.

It is being hauled for distances up to five miles. In peach, cherry and pear orchards it is used as a top dressing spread around the trees. On the truck farms it is spread with fifty yards to the acre and plowed under. The truck men use it under corn, tomatoes, celery, cabbages and melons. It is still impossible to obtain reports favorable to sludge, but the same farmers are drawing it after four years of trial and using more than ever before.

Cotton Pavements

A new material in road work has been employed on the highways of the Imperial valley, California. The sand in this section of the country makes it very difficult for automobiles to travel over highways which have not been surfaced with some other material. When cotton prices were down to a point where it hardly paid to haul it to market, some growers spread the raw cotton over the highways. The cotton pods seemed to sink down into the sand just far enough to hold the shifting sand in place and prevent the wheels from sinking in too deep. It is by no means a substitute for other paving materials but seems to serve its purpose of turning an impossible road into one that can at least be used by ordinary vehicles.

Record Road Construction

An unprecedented amount of road construction is being accomplished this season in Iowa, where 60 principal contractors with approximately 200 dirt moving outfits are handling a total of about 25,000,000,000 cubic yards of earth on the state primary road system. The total number of contractors engaged in the road construction is not less than 200, the majority of whom are sub-contractors for 50 or 60 larger firms who hold the contract with the counties. About 50 of the larger contracts provide for handling 100,000 yards or more of earth, much of which is moved by caterpillar tractors, hauling blade grader machines.

Operations were commenced unusually early by grading operations in March, many of the paving outfits being at work before the end of April and at the present time work is being executed at the rate of $2,000,000 worth per month.

During the month of July the average daily progress was 6 miles of permanent grading, 2 miles of gravel surfacing, and 1½ miles of paving on the primary road system, and it is expected that all of the time limit work will be completed this season. The general average price for grading has been 36.4 cents per yard with a minimum of 22 cents. Concrete pavement prices have been as low as $2.88 per square yard for 1½ mile section and bituminous filled brick $4.48 per square yard, gravel hauling and spreading averaged 61.4 cents per yard for distances not over 1 mile and 16.4 cents for each additional half mile. More than 207 miles of tile drains have been contracted for at an average price of 7.1 cents for 6-inch tile plus 8.5 cents for the labor.

Many of the contracts are large, some of them being for as much as 18 miles of concrete pavement and 22.8 miles of grading. Another grading contract 11.35 miles long involves moving 252,000 cubic yards of earth.

Inverted Siphons for Sewers*

Cleaning by hand. Stoppages very infrequent. Duplicate pipes. Ventilation. Essential principles. Massachusetts statistics.

Method (f) is used in the West Bartlett street siphon in Brockton.

Where inverted siphons are to be cleaned by hand, this generally implies the use of jointed rods with suitable scrapers or other tools attached at the forward end. The pipe to be cleaned must be emptied of water by either draining at a blow-off or pumping at a manhole, and during the cleaning operation the flow of the sewage must be diverted through another pipe, if there is a duplicate, or held back in the approaching sewer, or discharged through an overflow into a stream. Such overflows serve the additional purpose of providing for excess sewage flow during storms and preventing the sewage backing too far up the approaching sewer.

Access to siphons for hand cleaning is obtained through the manholes at their ends. If the siphon is built with inclines at the ends joined by a flat section, it is advantageous to have additional manholes at the breaks in gradient. In such cases either the manholes and their covers must be made to resist the pressure in the siphon or else the manholes must be carried up above the hydraulic gradient. The latter is objectionable because of the great probability that grease and other scum will rise into such manholes and finally form a solid plug, as was found to occur in the Dorchester bay siphon and in a 36-inch siphon at Wilmington, Del.

STOPPAGES IN SIPHONS

In spite of the reasons for anticipating deposits and stoppages of inverted siphons, stoppages are comparatively infrequent, even where the siphons are never cleaned. Experiences in several cities lead to the supposition that in many cases deposits do occur, but as such deposits reduce the free area of the siphon they thus cause an increase in velocity of flow, and finally a point is reached where such velocity is sufficient to prevent further deposits, and this more or less variable condition of equilibrium is thus automatically maintained and prevents complete stoppage of the siphon.

In at least two or three instances in the case of combined or intercepting sewers, further automatic action was found to be due to occasional considerable increases in volume of flow, due to heavy rainfalls which so increased the quantity and consequent velocity as to automatically flush out a part or all of the deposited matter at intervals.

In the case of a siphon at Wilmington, Del., A. L. Shaw made a careful investigation of conditions and computed that the probable velocity of flow through the net opening in the siphon, which was contracted by deposits, ranged from about 2.7 to 4.0 feet per second, or about the velocity generally accepted as necessary to prevent deposits and secure a certain scouring.

As stated, stoppages have been remarkably infrequent. Of the 145 siphons reported in Massachusetts in 110 cities, 88 were reported never to have stopped and only 14 stoppages were reported, the remaining not answering this question. When a stoppage does occur, however, it may be a very serious matter. Perhaps the most serious that came to the knowledge of the committee was one in Brooklyn in 1916. This siphon consisted of two 48-inch pipes for storm water and one 18-inch for dry weather flow. When this became stopped the sewage overflowed into a cut opened for subway construction, backed up into the subway and threatened to stop the operation of the trains by its depth. Rodding was practically impossible and flushing by hose was tried unsuccessfully. Finally a contractor was engaged to install four large centrifugal pumps at different manholes which pumped the sewage into the gutter, in which it flowed to another sewer. When the sewage was lowered, however, these pumps became clogged with heavy sewage and a sand pump was put into operation to remove the accumulated grit. This point was not reached until four days after the stoppage took place. It was then found that the entrance to all three pipes was completely obstructed with a mound of debris consisting principally of mattresses, a load of lumber of various sizes, a long-handled shovel, a pieces of bluestone curbing, a wooden barrel, several iron pails, bricks, pieces of concrete, tin cans, umbrella frames and large amounts of rags and other small rubbish. As soon as these were removed the sewage started to flow through the siphon, which required little additional cleaning.

About three-fourths of the inverted siphons in Massachusetts have but a single pressure pipe, but in a great many cases two, three and sometimes four parallel pipes are employed. At least two pipes would seem desirable. In the separate system additional pipes accommodate the increased volume of sewage that comes with lapse of time, without increasing the working head. Also, arrangement is easily made so that one pipe may be isolated temporarily for cleaning while the flow is carried by the other pipe or pipes. In the combined system, because of the great variations in flow, the use of two or more pipes is especially advantageous, one being reserved for dry-weather flow, while storm flow spills over side walls or wiers in the entrance chambers at the head of the inverted siphon, into the special storm pipes. It is generally desirable to separate the entrances to the several siphon pipes by walls or dams and use a similar construction at the downstream end of the siphon so that the dry weather sewage after passing through one pipe of the siphon cannot back into the other pipes in which there is no dry-weather flow, and stand there to cause deposits and putrefaction.

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*Continued from page 341.

While the inverted siphon is always full of water after once being put into service, unless it is drained intentionally, before actual use and when being cleaned it will generally be empty and therefore buoyant if below the bed of a river. This should be taken into consideration and provision made if necessary to prevent its floating to the surface of any body of water under which it passes.

VENTILATION

In this country no attention seems to have been paid to the ventilation of inverted siphons. If the hypothesis made in the previous paragraph, that siphons retain deposits until the bore has contracted a sufficient amount to enforce a velocity of 2½ to 4 feet per second, is correct, then there is almost sure to be putrefaction taking place in such inverted siphons. Probably most or all of the gases of putrefaction are absorbed by the sewage flowing through and may or may not be released when the pressure is relieved when the sewage emerges from the siphon. Instances of such release of gases have been found in this country, one of the best known being that of the Los Angeles outfall sewer built in 1895, where two siphons of wood stave pipe, each about 3.4 miles long, are joined by a section of brick-lined tunnel. A few years later a strong odor was noticed at the outlet from the upper siphon and at a 12-foot vertical drop in the sewer about a mile and a half below, and at these points the cement in the masonry was found to be disintegrating rapidly. A similar experience is reported in connection with the inverted siphon of the metropolitan sewerage works. In one manhole after having been closed for a year and a half the mortar in the brick work was found to be soft like putty.

ESSENTIAL PRINCIPLES

The committee concluded its report by quoting the following essential principles as set forth by S. B. Bleich in a paper written in 1917:

"1. Complete and effective separation of the house sewage and industrial waste from the storm run-off at all times.

2. Simplicity of construction.

3. As slight and easy changes in direction of flow as are practicable at the entrance and exit legs.

4. Easy curves where necessary.

5. Uniform section throughout entire length of siphon pipes.

6. Elimination of all features tending to obstruct flow.

7. Omission of all moving parts and mechanical devices.

8. Provision for easy access to all pipes without impairing any of the essential features.

9. Entrance and discharge openings to have sufficient area within the available height not to cause any back-water; and change of section or direction not to be too abrupt."

MASSACHUSETTS STATISTICS

Accompanying the general report above abstracted, the committee submitted six appendices, giving respectively a tabulation of the answers to the questionnaire, analysis of these data, detailed descriptions of certain inverted siphons in Massachusetts, data relating to certain inverted siphons outside of Massachusetts, notes relating to siphons outside of Massachusetts and a bibliography.

The questionnaire submitted to Massachusetts cities was sent to 110 cities having sewerage systems and 45 returned data regarding 145 inverted siphons in their systems, about ⅔ of which were on domestic sewers, ¼ on combined or storm water sewers and 8 on the metropolitan main lines.

Cast iron was used for about ⅔ of the cases, about 20 siphons were of vitrified sewer pipe, about a dozen were of concrete, some plain and some reinforced, and about a dozen, under light pressure, were of brick.

The smallest pipe reported was 4 inches and the largest 78 inches. The majority of the pipes seemed to be 6, 8 or 10 inches. Blow-offs for emptying the siphon were reported in 18 cases. In 16 siphons sumps are reported at the upper end, at the lower end in 32 cases, at both ends in 17 cases and 58 had sumps at neither end

In the matter of maintenance, the principal reliance is placed on flushing. Of 83 siphons concerning which this information is given, 54 use flushing, supplemented by hand cleaning in 32, while in 11 cases hand cleaning is the only method employed. In about ⅓ of the cases where flushing is used, it is applied once a year in about the same number of cities at intervals of from 2 to 6 months, in about half as many at intervals of from 1 to 4 weeks, while in two Concord siphons the sewage is stored and automatically discharged at intervals of between 2 and 3 hours.

None of the siphons reported upon in Massachusetts has ever had to be dug up on account of stoppage, but 14 cases of serious clogging were reported in 10 different cities.

PUBLIC WORKS

Published Weekly
by
Public Works Journal Corporation

Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba..$3.00 year
All other countries ....$4.00 year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

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Pass a Federal Aid Road Bill

Public Delay by Congress in passing a Federal aid road bill "is working infinite mischief throughout the country, actually threatening to make the unemployment crisis worse instead of relieving it." These are the words of the sub-committee on Public Roads of the President's Conference on Unemployment. In Minnesota, for instance, if a new Federal appropriation is not made at once more than twenty thousand men and hundreds of teams will be thrown out of work, and in Pennsylvania a number nearly as great.

That is the direct result. In addition, stopping road building means shutting down of quarries, cutting of the market for cement and other materials, the working of gravel pits, the manufacturing of road building machinery, and other industries related more or less directly to road building.

On the other hand, the immediate passing of a bill making a liberal appropriation for road work would enable states all over the country to furnish work throughout the winter to thousands who will otherwise suffer and possibly become, with their families, public charges, because of unemployment.

The Cities' Responsibility

But the cities and states also can do much to solve the problem, and to the extent that they can do so the responsibility is theirs as well. Probably no city has not some public work in view that is either fully planned or at least definitely accepted as desirable, if not absolutely necessary. Now is the time to put it under way. When private enterprises are holding back is the time for public ones to expand. And this for several reasons. Perhaps the most important is that it furnishes employment when it is scarce rather than when it is abundant. Also, it can justifiably get it at lower rates instead of competing with private enterprises and unnecessarily boosting wages, as is the effect of public works done in boom times. Moreover, many of those who support themselves by giving their services to the public in exchange for wages, would, if unemployed, be supported by the same public through charity without giving any service in return; and the city would lose rather than gain by refraining for spending money for public works.

As for the money, it would be raised by bonds to be paid for during several years to come, when times will be better, we all are certain.

As an example of what many cities are doing, Joseph H. Gainer, mayor of Providence, writes us:

> The city council at my suggestion created a Joint Special Commitee with power to consult with the heads of the various departments to ascertain what public work under the city auspices might be begun at the present time. This committee is now making plans which it will announce shorty.
>
> In addition to this, I have called together leading manufacturers, business men and labor leaders of Providence and had them form themselves into a Citizens Committee for the relieving of unemployment. This Committee will attempt to do two things. First, it will open a registry bureau where an attempt will be made to get an accurate knowledge of the unemployed in Providence Secondly, it will endeavor to arouse a public sentiment which will furnish work to which the unemployed may be directed. I expect the City Council Committee and the Citizens Committe will work in harmony.
>
> Prior to the creation of either committee, we had started two matters of importance. Recently we let the contract for the main dam on our new Water Works project, the matter involving several million dollars. A provision in this contract required that, other things being equal, local labor and local supplies should be obtained by the contractor. A new road contract on the water development project was let with even more rigid restrictions as to local labor, the contractor agreeing to employ all but seventeen of his force of one hundred men from domiciled inhabitants of the City of Providence. Two weeks ago we let the contract for a New High School Here again the contractor agreed to employ local labor and buy his supplies locally wherever it was possible to do so.

Public Works as an Equalizing Reservoir

But it is to be hoped that cities and states will not allow the matter to drop with the passing of this emergency. For the reasons already suggested and others, certain public works can to advantage be speeded up or held back as labor conditions may make desirable. Such works of great magnitude, extending over years in their construction and through generations in their enjoyment by the public, can be regulated in this way as private works could not be.

To provide for such depressions as the present, work of this kind should be planned by each city to extend over a series of years and act as a powerful stabilizing influence, to be shut down entirely when private enterprise is at a peak and pushed to its fullest extent when there is a depression in general business. Pennsylvania and California have already legislated machinery for this purpose. Surely other states and cities can exercise the same foresight.

Recent Developments in Water Works Matters

The report of the Committee on Water Works and Water Supply of the American Society for Municipal Improvements, of which Nicholas S. Hill, of New York, is chairman, was an excellent survey of the present status of water supply practice and of recent progress along the several most important lines of development. The general features dealt with included personnel, ownership, economic development, uniform accounting, standard materials, pumping machinery, rainfall and run-off records, works for the collection and distribution of water, standards for water quality, water softening, water supply and disease, water purification, and electrolysis. Each of these subjects was discussed at greater or less length, and the length of the report unfortunately renders it impracticable to reprint it entire in Public Works. We have endeavored, however, to present in the following paragraphs quotations and abstracts which give a general idea of the points brought out by the committee.

PERSONNEL

Under the head of personnel, particular attention was called to the importance of securing the best men available.

"The health and safety of every resident depends upon a proper water supply and the time has come when the public, which owns the great majority of the water works in this country, and municipal officials in particular, should be brought to a realization of the responsibility which they intrust to water works officials and to recognize the folly of denying those officials the compensation and other advantages of men performing like work for private industries.

"It is difficult to estimate the total sum of money invested in water supplies in the United States because statistics are not available from which such information can be gleaned. It is a fact, though, that except for playgrounds and parks, the money invested in no other branch of municipal activity even approaches in amount that invested in water works plants. It is absolutely essential, therefore, that the men charged with the responsibility of the administration of water departments should be qualified for the work on economic grounds alone. It is penny wise and pound foolish to select mediocre water works officials simply to save a small amount in the salary account when, on the contrary, only men trained and experienced in the specific work of water supply management should be engaged.

"While progress in the administration of water works has been made, there is a marked lack of expert supervision due to the inadequate salaries paid to municipal employees of the water works departments. Specifically, the results obtainable through expert supervision of a water works are:

1. Better service.
2. Reduction in cost of operation.
3. Proper anticipation of future requirements.
4. Improved design.

"Better service means an ample quantity of pure and clear water for domestic and industrial purposes and safeguarding the community against disastrous fires. Decreased cost of operation means supervision of all details of operation in such a manner that effective service will be rendered at minimum expense. Anticipation of future requirements means that all necessary increases in the supply and equipment will be foreseen so that they may be provided before the community is reminded of its needs by destructive fires, inadequate equipment, or disas-trous epidemics due to the pollution of the water. Improved design will result from expert knowledge of operating conditions."

Under the head of ownership it was stated that four-fifths of the public water supplies are municipally owned and the tendency toward municipal ownership is growing in spite of the greater cost of municipally than of privately administered plants, the public being willing to pay the price for the added security it feels under municipal ownership.

ECONOMIC DEVELOPMENT

Under the head of economic development the report states that municipal plants as a rule are notoriously inefficient and operated on absolutely unsound economic principles. Municipal water works should be operated on the same economic principles as those on which a private utility would operate and the former should make the same reasonable charges for water as would the latter. Every charge that is made for water should be based on the fundamental principle that the revenue must equal the expenses. Some of the revenue, however, should come from taxation and some from water rates, and the distribution of these should be the same whether the plant is municipally or privately owned.

At present in some municipal plants the water rates are so high as to cover all operating expenses, pay interest and sinking fund charges and even turn in excess earnings to the city treasury for general purposes. On the other hand, in some municipalities the water rates are insufficient to pay operating expenses alone and these are made up from the general tax levy; while in still other cases the interest on the water works bonds is paid from the tax levy and revenue from water rentals is used for operating and maintaining expenses.

It is possible to determine what proportion of the expenses of the department should in equity be derived from water rates and what from the public treasury, and unless such relation is determined and acted upon in the fixing of rates, the officials operating the department will not feel a proper sense of responsibility for making the utility an independent, self-sustaining institution.

UNIFORM ACCOUNTING

Attention was called to the fact that it is almost impossible today to compare the results of the operation of water works plants in different places. Public utility commissions in various states have prescribed uniform accounting systems, but few of them have power to enforce them on municipal plants. The general use of a uniform system, permitting comparative studies of operating costs and expenses, is prerequisite to the establishment of equitable and just rates. The committee believes that the cost of municipal operation in general could be greatly reduced if the accounts enabled the heads of municipal governments to properly segregate costs and by analytical studies see whether expenditures were properly or improperly made.

"Operating reports of water works have been pretty generally standardized and in this respect present conditions are an improvement over those which existed in the past."

PUMPING MACHINERY

A brief history is given of the development of pumping machinery from the first modern pumping engine brought out by Henry R. Worthington about 1840, through the development of the duplex, direct-acting pumps, which have reached an efficiency of 170 to 180 million foot pounds.

"All of the pumps up to fifteen or twenty years ago installed in water works plants were of the reciprocating type, either direct acting or crank and flywheel, or either vertical or horizontal pumps, as the case may be. The term 'reciprocating pump' covers all pumps in which the water is displaced by a plunger, piston, or bucket, working back and forth in a cylinder. The past fifteen or twenty years marks the development of the centrifugal pump, although in 1680 the first centrifugal pump was built, and 1818 was the year when the first crude pump of this type, called the Massachusetts pump, was built in this country. It is probable that the centrifugal pump did not come into general use because of the fact that it is a relatively high speed machine and there was no motive power well suited to it, but with the introduction of the steam turbine and electric motor, conditions have changed. These high speed machines stimulated the development of the centrifugal pump and we now find an ever increasing demand for this type of machinery.

"Probably another reason for the delay in demand was due to the low efficiencies of the earlier types of centrifugal pumps, but at the present time turbine-driven centrifugal pumps of large capacity have been installed in water works plants which have produced duties of from 135 to 165 million foot pounds per 1,000 pounds of steam as compared with 170 to 180 million for the best types of reciprocating engines.

"When the low first-cost of the turbine-driven centrifugal pump is taken into consideration, it makes a very attractive proposition for large water works. In small isolated water works the electrically driven centrifugal pump offers many inducements, and there are to be found now many installations of centrifugal pumps which are driven by producer gas engines, oil engines of the Diesel type, and gasoline engines. The tendency towards centrifugal pumping machinery is notable and marks a step in the evolution of water works design."

RAINFALL AND RUN-OFF RECORDS

Stressing the importance in all water works designing of a knowledge of precipitation and run-off, the committee expresses its belief that: "A knowledge of the amount of run-off in various localities and in various watersheds is absolutely essential to the proper design of dams and reservoirs. One of the great difficulties which the water works engineer had to contend with in the past was the absence or paucity of suitable rainfall and run-off data. Great strides have been made in maintaining gauging stations for the purpose of recording the run-off of streams in various parts of the country. These have been of invaluable assistance in the proper and secure design of water works. Few people recognize the value of maintaining rainfall and run-off records. This committee begs to call its importance to the attention of the municipal officials and to request that they encourage the maintenance of such records in the states in which they live, and to the water works officials here present a request is made that they maintain such records on the watersheds under their jurisdiction and control."

QUALITY AND PURIFICATION OF WATER

"In certain sections, the northeast particularly, waters having colors of 25 or more are still used without complaint. These colors would not be tolerated in western cities supplied with lake or filtered water. Even in New England, public opinion is fast getting to a position to demand water of an average color of 10 parts per million or less with a maximum of 15. Particular objection is made to colored surface waters containing odoriferous organisms, and turbidity, whether due to heavy microscopic growths, to clay, or to iron rust, is also objectionable."

Softening of water is important from a commercial much more than from a health standpoint, hard waters being objectionable for domestic and laundry use, for boiler use and for many industrial processes. It is probable, therefore, that increasing competition between cities for attracting industries to them and the rising standards for domestic water supplies will lead to a substantial growth in water softening. The progressive city with an ample supply of soft water will grow while others will stand still. In addition to the lime-soda process in use for 70 years, artificial zeolites, of which "permutit" and "delcalco" are trade examples, have had wide-spread use in the industries and are beginning to enter the municipal field.

There is a consensus of opinion that storage is perhaps the most reliable single method of purification of water, although not free from the danger of wilful or accidental contamination.

The use of the "hydraulic jump" to mix chemicals with water, introduced by J. W. Ellms in the Milwaukee experiments, seems to be a simple and effective substitute for the older methods of baffled channels, agitators, wiers and other mixing devices.

"Where filtration and softening are combined, difficulties resulting from the so-called balling up of the filter sand, due to the accretion of lime deposits on the sand grains in the filter beds, are being overcome by several methods which have been developed recently."

In the matter of treating colored waters and those of low alkalinity to produce an effluent free from color, turbidity and colloidal aluminum hydrate, the committee calls attention to the use of hydrogen ion concentration as a measure of the reaction of the water in adjusting treatment to condition.

The existence of a filter plant gives a feeling of security to a community, but such a plant operated without proper supervision may be but a blind to camouflage a really critical situation. Every filter plant should receive sufficient supervision by expert chemists and bacteriologists to insure its efficient and safe operation. Many cities are realizing this and most of the state health departments. The state of New Jersey is believed to be the pioneer in requiring all filter plant operators to be licensed, the laws of that state requiring that every purification plant must have a licensed operator, the license being obtained from the State Department of Health after an examination calculated to prove him to be capable of performing the duties attached to such position. Licensing of operators and making daily routine analyses, however, will not insure the desired end unless the water works superintendent uses such analyses, applying them intelligently to the operation of the plant.

ELECTROLYSIS

The committee refers to the American Committee on Electrolysis, consisting of representatives of the electric railway, electric light, telephone, gas and water interests, which has already made one report on the subject of electrolysis and is expected to make a second within a short time. Active committees now exist in Chicago, Kansas City, Omaha, St. Paul, New Haven, Milwaukee and Syracuse, composed of technical representatives of the several utilities of the city concerned in the matter, to investigate the local electrolysis situation and determine by agreement the course of procedure to be followed. The railroad commission of Wisconsin has authorized an electrolysis committee in that state to act as a clearing house of information and provide for joint electrolysis surveys and the installation of unified methods of mitigation.

Granite Block Pavement*

Present methods of mixing and applying filler and improvement possible. Sand and grout filler. Necessity of ramming.

By Clarence D. Pollock †

The standard granite block pavement as now laid is placed on a cement concrete foundation, usually six inches in thickness, with a cushion of one inch of sand or a mixture of cement and sand in the proportion of one part of cement to four parts of sand by volume. The standard block 8 to 12 inches in length, 3½ to 4½ inches in width and 4¾ to 5¼ inches in depth is generally used. Where traffic conditions are such that the street cannot be blocked off for a sufficient time to permit the grout to set properly, an asphalt mastic filler is quite generally used.

BITUMINOUS FILLER

This asphalt mastic filler is of rather recent origin, but has been very satisfactory when properly mixed and placed. In place of the asphalt, a coal tar pitch is sometimes used, and also a mixture of coal tar pitch and asphalt. The coal tar pitch and sand alone has not given very good results, but a mixture of five parts of coal tar pitch with one part of asphalt has given much better results, as it is less susceptible to temperature changes than the coal tar pitch alone.

The usual specification for the bituminous filler calls for a mixture of the paving cement and hot, dry sand in the proportion not to exceed one part of sand to one part of the paving cement by volume, or as much sand up to this proportion as the paving cement will carry. The sand is usually specified as all to pass the 10 mesh sieve or all to pass the 10 mesh and 80 per cent the 20 mesh sieve.

The common method of mixing this bituminous mastic is to draw the hot asphalt or pitch from the heating kettle into a steel push cart or a wheel barrow and then shovel in hot sand, counting the shovelfuls and then stir with a perforated hoe or rake. In some places a small gasoline mixer is used. These methods are crude and it requires great care in order to secure good results. If the sand is coarse, or damp, or if too much is added, the mixture will not run into the joints and completely fill them. Coarse sand will settle out and lodge in the closer joints and dam up the mastic. Too much sand will make the mixture so stiff that it will not flow into the joints. The usual practice is to dump the hot mixture from the push-cart or wheelbarrow upon the surface of the pavement and push it into the joints with a hoe or a squeegee. This operation should be carried out rapidly and care used not to push the mastic out so thin that it will chill before it can penetrate the joints fully.

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*Paper before the Paving Conference held in Philadelphia October 20 and 21.

†Consulting engineer of New York City.

The asphalt should be homogeneous, its melting point between 115 and 130 degrees Fahrenheit, not less than 98½ per cent soluble in carbon tetrachloride, its penetration at 77 degrees Fahrenheit not less than 60 nor more than 100, and at 100 degrees Fahrenheit its penetration should not be more than 3½ times that at 77 degrees. Its ductility at 77 degrees Fahrenheit should not be less than 40 centimeters at the penetration called for; it should not lose more than 3 per cent by volatilization when maintained at a temperature of 325 degrees Fahrenheit for five hours, and the penetration of the residue after sucn heating should not be less than one-half of the original penetration.

After the hot paving cement and sand mixture has been flushed into the joints thoroughly, a small amount of clean sand should be spread over the surface.

The sand used in the mastic should be a uniform fine-grained sand, as this will remain in suspension better and will not clog and dam up the closer joints and thus prevent the flowing of the filler. As was mentioned above, the present mixing methods are crude. The gasoline mixer is an improvement on the hand mixing, but there is a good opportunity to devise more accurate methods of measuring the materials in order that the amount of sand used shall be uniform. It is also desirable that tests be made to determine more accurately the proper amount of sand to use. This should be as much as possible and still permit the mixture to flow readily into the joints. From observation this would seem to be in the neighborhood of about 40 per cent, but we hope to see some test sections tried, varying the amount of sand from say 30 to 50 per cent, using a good fine sand such as an asphalt sand.

This filler in its crude state has proved so satisfactory that it seems well worth while trying to eliminate as much of the guesswork as possible and make it more "fool proof."

CEMENT GROUT FILLER

In connection with the cement grout filler, the greatest improvement has been the more general use of a machine mixer, such as a small batch concrete mixer with a spout or trough, which delivers the grout directly onto the pavement. This gives much more uniform results than the old hand method of mixing the grout. Here also it is important to use a uniform fine grained sand in order that it may be held in suspension until delivered in the joints of the pavement.

To obtain good results with a cement grout filler even greater care and attention to details is required than with the bituminous mastic. Any carelessness, such as permitting sand to get part way up in some of the joints so that the grout does not penetrate to the bottom, will cause bad defects in the pavement, as the thrust from expansion will have to be carried by the upper part of the joint and this will crush the heads of the blocks.

RAMMING AND CUSHION

Since the general use of the shallow cushion between the blocks and the foundation, there has been a tendency to slight the ramming. This is wrong. It is just as important as ever to ram the blocks thoroughly and then back-ram them after raising any low blocks. If this is not done the traffic will later pound down the shallower and more poorly bedded blocks and a poor surface will be the result.

With a cement grout filler and heavy traffic an improvement has been the use of a dry cement mortar cushion of one part of cement to four parts of sand. This gives a very solid and firm pavement, as the mortar cushion has an opportunity to set while the grout is getting its set. This cushion has been used in some places with a bituminous filler, but here the traffic is permitted to pass over the pavement before the cushion can obtain much of a set and it would seem to be a waste of money to use the cement in the cushion. It will set in places where traffic does not pass over it and the set will be broken where it is subjected to traffic.

IMPROVING THE FILLER

The present standard block specification with proper inspection produces about as good a block as can be made without making the cost prohibitive. With good inspection these can be paved with close joints and with thorough ramming a good surface can be obtained and maintained; but, as has been suggested previously, while there has been considerable improvement in the joint filler, there is still opportunity for much improvement.

It is urged that the engineers of municipalities having charge of granite paving work try out various mixtures of sand and asphalt and thus find out in actual service what is the best mixture within reasonable working limits. In such tests care should be taken to use uniform fine grained sand which is thoroughly dry and hot. This mastic should be agitated by mechanical means until it is flushed into the joints. The crude method of heating the sand by placing it over iron pipes containing wood fires, as is still frequently done, should be avoided. Fine hot asphalt sand, when it can be obtained, gives the best results. A practical method of measuring the sand and asphalt should be provided, as the method that is now quite general of using a shovel to measure the sand is crude and does not give uniform results. Proper attention to these details should produce a filler that will make the modern granite block pavement about as near an ideal pavement for heavy traffic as it is possible to produce at a reasonable cost.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How Should Aggregate for Road Concreting Be Stored and Delivered?

Many good systems have been developed which should be considered and selections, modifications or changes made to suit local conditions and requirements. Operations and equipment should be completely scheduled in advance.

The construction of an 18-foot concrete pavement or foundations for an asphalt or block pavement is likely to require about ½ yard of stone and approximately one-half as much sand per linear foot, amounting to a total of between 5,000 and 6,000 cubic yards of aggregate per mile of road, exclusive of any that may be required for culverts, bridges or other structures.

The problem of insuring a sufficient supply delivered so as to be certain to be always available when required and not to overload storage facilities if they are limited, stored advantageously for loading and unloading and delivered most easily, quickly and reliably, and all done so as to secure the greatest ultimate continuity and rapidity of work and economy of construction and with a minimum of waste or delay is a very important problem, on the correct solution of which depends the success of the job and often the realization of any profit to the contractor.

Within the last few years many different methods have been employed for storing, handling and distributing the aggregate, measuring it and delivering it to the concrete mixer and a considerable quantity of special equipment has been put on the market for this purpose, adapted to various systems that have been developed by manufacturers and are strongly urged by them to promote the sale of their products.

Many, if not all, of these systems and appliances possess considerable merit, but none of them are equally desirable for all conditions. It is, therefore, necessary on any job of importance to plan the working methods and operations and the equipment installed in accordance with the local conditions and requirements and to conform to certain general factors that are more or less vital to any concrete paving job.

Some of these factors will be here briefly considered, and it is assumed that the work is comparable in design and requirements with the trunk line work of the various state highway departments for whom a very large proportion of concrete road construction is done, and that it is to be executed chiefly in suburban districts where concreting operations are proscribed by climatic conditions during the winter months, as is the case, except in the southern portion, in the United States.

Among the principal factors governing the storage, handling and distribution of the aggregate are the size of the job and the rapidity with which it must be constructed; the equipment already possessed by the contractor; the sources of supply for the sand and stone and the rate and regularity with which it can be supplied from the source to the contractor; the length of haul and character of roads over which the aggregate is hauled; traffic conditions; width of road; topography; climatic conditions; availability of new equipment; and considerations of probable future construction contracts.

If the job is very large or if it must be done with great rapidity or there is a special scarcity of labor a larger amount of equipment is justifiable or is even necessary than for small jobs that may be occasionally executed slowly with an abundance of cheap labor. Generally speaking, however, any equipment is justified which will save enough labor cost to pay for itself on the given job. In which case the question arises, not as to provision of equipment, but as to the choice between different kinds of equipment. In any event the equipment purchased should be first class and standard. Whatever methods and plans are adopted it must be remembered that unless sufficient tools and apparatus are provided to insure the continuous employment of the men, heavy losses will be incurred through the payroll and disorganization of morale will certainly follow; that mechanical equipment works continuously day and night and never goes on strike; and that the saving of a few men's wages daily soon pays for the expensive equipment and that usually has a high salvage value after the work in hand is completed. The method of handling and distribution of aggregate should therefore be planned with a view to utilizing to best advantage the equipment already possessed by the contractor and to supplement it if necessary by additional equipment especially suited to the existing conditions.

If a contractor is abundantly supplied with a certain class of equipment which makes it possible to do the work at a moderate unit cost it may be better to use this equipment than to sesure new equipment at a high price that will execute the work at a smaller unit cost. If such a question arises a careful estimate should be made for the total cost of doing the work by each method with proper allowance for greater rapidity and the elimination of overhead charges and risks due to delay, and it may be found that the job will have to be a very large one to justify securing the reduced unit cost with heavy initial outlay.

If the aggregate is imported from a commercial dealer it may be necessarily delivered at a single point, either by rail or water, where it will pay to establish unloading, storage and loading facilities commensurate with the size of the job, and in any case designed to secure the greatest convenience and expedition of operations and insure a continuous supply with a margin of excess above current requirements at a minimum total cost for the whole work. In other cases it may be possible to have the materials delivered at several points or even distributed along the work in case the latter is closely paralleled by any commercial delivery system whether it be by water, by rail or by highway. It may also be possible to secure the supplies from two or more sources that can advantageously deliver to different points or if it is delivered by the seller with automobile trucks, arrangements may be made with him to deliver it exactly as required for the progress of the work by daily notice of the amount and at the points desired, thus entirely avoiding rehandling or storage.

If the aggregate or portions of it are dug or quarried by the contractor himself he may either arrange to get out a large quantity in the winter season or in idle times and store it for use as required or to produce it in quantities slightly in excess of the demand and deliver directly to the paving machine as required.

The method of distribution depends considerably on the length of haul and the character of the road over which the haul is made. Very short hauls on level roads where the principal time consumed is in loading and unloading, may be advantageously made with teams. Longer hauls with motor trucks, or trucks and trailers, or trailers drawn by tractors, especially if the roads are poor or the grades are heavy. For moderate grades and long hauls, such, for instance, as to remote parts of a very long section of road construction, industrial tracks and dump cars or flat cars with batch boxes, drawn by gasoline or dinky locomotives are likely to be economical and desirable.

It is also necessary to consider the existing traffic conditions provided traffic is maintained over the road itself if the work is the reconstruction of an old road, and arrangements must be made so that traffic will not seriously interfere with the delivery of aggregate or that the delivery of aggregate will not greatly impede the traffic. In either case, plans should be perfected enabling both traffic and hauling to utilize as much as possible the undisturbed surface of the old road and the completed surface of the new road with as small a distance as possible traveled between these two sections.

It is, of course, always a desideratum to have the traffic detoured so that the contractor will be in full possession of the right of way at the points where construction is in progress. If, however, traffic must be maintained it is sometimes possible by means of a little rough grading to provide for it alongside the working points without serious inconvenience to the public or the contractor.

If the road is 18 feet or more in width it is also possible, if permitted by the engineer, to make it in two successive longitudinal halves, diverting the traffic first to half of the original roadway surface while the first half of the new road is built and then opening that to traffic while the second half is built alongside. Substantially the same procedure may be followed when the road is built, as has sometimes been done, with two one-way strips of concrete surface on each side and a narrow central strip of macadam, a type of construction which is considerably cheaper than a full width continuous concrete surface and is claimed to be at least equally desirable. Roads less than 18 feet in width can hardly be constructed in halves to advantage, and must, therefore, be completed full width at a single operation and the aggregate delivered accordingly.

If the contractor is reasonably assured of long-continued good weather in which he can work practically every day he must provide for the delivery and distribution of the aggregate accordingly and it must all be stored in advance or he must have certain assurance that it will be forthcoming regularly after the commencement of the work. If there is likely to be considerable inclement weather or predetermined interruptions to the work, it may be possible for him to arrange for the production and distribution of the aggregate during this time so as to reduce the maximum peak of production and transportation and the total amount of simultaneous storage.

If the right of way is wide enough and unobstructed the contractor may be able to distribute the aggregate in advance alongside the roadway, perhaps during the winter months, when other construction operations are prohibited and when his motor trucks and men have plenty of leisure. If such is the case, it may eliminate the question of central storage and of loading and unloading machinery that otherwise would be important.

In the selection and purchase of new equipment, such as industrial tracks and cars, dump cars, batch boxes, motor trucks, storage bins and loading and unloading apparatus the contractor must also be assured that such purchases will be delivered in time for the certainty of their availability promptly when required, because if they were missing when he was ready to commence the work or a certain portion of it, the entire schedule of operations would be dislocated and great loss and confusion might ensue. It should, therefore, be of standard design and furnished by the most reliable and well-established dealers.

In the decision between hand work and machinery and especially in the selection of the different kinds of plant and equipment, due weight should be given not only to the particular job for which it is purchased, but to the amount and character of the work the contractor has reasonable assurance of doing in the immediate future. If he can foresee considerable quantities of similar work and a strong chance that he can secure the contract he will be justified in buying special appliances that will be profitable in the long run, while they would not be advantageous for a small amount of work that might be done satisfactorily by hand at a somewhat larger unit cost and save the investment. In other cases he might find it more desirable to use general equipment that sufficed for the present occasions and was more adapted to miscellaneous construction in case there was uncertainty of his continuing road construction. In any event all of the equipment purchased should be thoroughly standardized and of as few different types and sizes as possible so as to make the units and pieces interchangeable, allow for a minimum number of spare parts and secure the greatest efficiency of operation by the workmen.

The unloading and storage of aggregate at a central plant can be handled by any of the various methods described in Public Works, pages 435 and 457, vol. 50, or by modifications or combinations of them less suited to the special conditions. The measuring of the aggregate at the central plant is very generally adopted and in most cases or all will be found to be more rapid, convenient and economical. The use of batch boxes for its transportations provide for the automatic measurements and convenient handling at both ends. These may be purchased from regular dealers or they can often be advantageously made of wood by the contractor's regular forces during the winter or in stormy weather or dull times.

If batch boxes are not used their equivalent can be used by transporting the materials in motor trucks, the bodies of which are separated by one, two or more swinging partitions with intermediate spaces holding a single batch of materials, provision being made for the successive dumping of these separately without one unit interfering with another. When this is not convenient the aggregate may be loaded into tilting buckets placed on a chassis or flat car or dumping by gravity when the latches are released.

If industrial tracks are used the dump cars should carry single batches or batch boxes should be loaded in sets of one, two or three on flat cars, and the flat cars or dump cars hauled in trains of suitable length with provision very carefully made for returning and outgoing trains to pass each other en route and for rapid continuous movement of full and empty cars both at the mixer and at the storage plant so that no time is lost in waiting for full or empty cars. Various arrangements of the industrial track can be made to secure the greatest movement and most convenient handling of the trains. They may sometimes form a loop around the storage plant and another around the concrete mixer, another may be provided with Ys and switches and crossovers or they may be double or single lines according to the amount of materials handled, the character of the right of way and the amount of track available.

If a continuous supply of aggregate is certain and a given number of cars or boatloads of it daily can be depended upon it is possible to keep only a small storage pile in reserve and to unload aggregate as received by a derrick and clamshell or by a locomotive crane running on a track between the railroad siding and the industrial track where the cars are and filling the latter as they arrive. Batch boxes are generally unloaded by a small derrick installed on the paver and the latter is universally charged with an elevating hopper, operated by its own power.

When the aggregate is distributed along the right of way in advance of the concreting it may be delivered to the paver by wheelbarrows or hand carts. There have, however, been put on the market loading and measuring machines that are installed adjacent to the paver and consist of some sort of a continuous belt conveyor or its equivalent that is easily fed by men shoveling from the piles alongside. This method saves considerable labor and makes for greater speed and continuity in serving the paver.

When a contractor has only a single job to execute and is already provided with a portion of the equipment necessary for the work he may be able to supplement it by some other equipment that he possesses or by purchasing only a small amount of additional equipment, as, for instance, when a contractor has only a few thousand feet of industrial track and has to haul a mile or more he may use the industrial track until the work progresses beyond its limits, and then establish at the end of this track a gantry or other lifting device by which the aggregate can be quickly transferred from the cars to trucks that will carry it the remainder of the distance and thus enable both the trucks and industrial tracks to be in simultaneous operation to advantage and with their combined efforts to handle nearly twice as much material as either could alone.

Newspaper Aid to Unemployment

The Toledo "Daily Blade" has offered to do its part in relieving the unemployment by publishing without cost notices of odd jobs that the Toledo citizens may want done, such as cleaning cellars or attics, raking leaves, cleaning furnaces, etc. These free notices will be printed under the caption of "Help Wanted, Odd Jobs." This would seem to be a practical aid in solving the unemployment problem which might well be imitated by newspapers in all cities throughout the country. The amount involved in these odd jobs is not sufficient to warrant the private citizens in advertising for help, and, in fact, they probably could obtain it without advertising; but the bringing of such odd jobs to the attention of those who are really anxious for work should prove of real assistance in enabling many to obtain it.

Recent Legal Decisions

COUNTY'S RIGHT TO SUE FOR CONTRACT PRICE OF BRIDGE DESTROYED BY WATER

The Kansas Supreme Court holds, Board of Commissioners of Trego County, 198 Pac. 954, that where a county contracts with a builder for the construction of a bridge on the county line and pays the builder the full contract price, although the adjoining county reimburses the contracting county for one-half of the contract price, the latter county may maintain an action against the builder for damages for the entire contract price where the bridge, on account of noncompliance with the plans and specifications, is destroyed by high water.

CONSTRUCTION OF STATUTE RELATIVE TO WARRANTS FOR 80 PER CENT OF WORK DONE

The Iowa Supreme Court holds that Code Supp., 1913, sec. 1989, art. 34, providing for the issuance of warrants to a drainage contractor for 80 per cent of the work done during the progress of the work on the engineer certifying the same is mandatory, the legislature evidently intending that contractors under this statute should not be required to wait until the completion and final acceptance of the work. For any sums claimed above the 80 per cent the contractor can sue in quantum meruit, and is not entitled to a writ ot mandamus. The county might file a counterclaim for any injury suffered by the work not being completed to the satisfaction of the engineer, and would also have a right to an independent action on the contractor's bond.—Farmers' Loan & Trust Co. v. Wright County (Iowa), 183 N. W. 500.

DRAINS AND SEWERS DISTINGUISHED IN LEGISLATION AUTHORIZING CONSTRUCTION

The Ohio Supreme Court holds, Roebling v. City of Cincinnati, 132 N. W. 60, that, although in common usage the words "drains" and "sewers" are to some extent synonymous and interchangeable, when applied to public street improvements they are distinguishable, and legislation by the council of a municipal corporation under the Ohio statute for the improvement of a street by paving and providing for the construction of the necessary drains as an incident thereto, is not broad enough to clothe the city with jurisdiction to construct a sanitary sewer thereunder.

A drain, the court says, is an incident to street building. No engineer would think of constructing a street without providing for its drainage. It is an essential element of good workmanship and substantial construction, and it is highly important that drains be provided to prevent the accumulation of water upon the surface of the street and adjacent territory, for the purpose of preventing early decay and deterioration of the street. By reason of its construction a street may receive surface water, and frequently does, from territory outside of its own compass, from the terraces of abutting property and from the roofs of houses thereon.

The term "sewer," on the other hand, when applied to city improvements, means a large, underground passage for fluid and feculent matter —the refuse and filth necessarily present in populous centres—by means of which this matter is carried off. A sewer is employed for the convenience of the people, and its prime purpose is for the benefit of the health of the public.

FRANCHISE WATER RATES CONTROL THOUGH TEMPORARY CONTRACTS HAVE BEEN MADE WITH MUNICIPALITY

In an action against a municipality for water rates, it is held, Waterloo Water Co. v. Village of Waterloo, 189 N. Y. Supp. 906, that water rates fixed by a franchise to furnish water to a village and its inhabitants are controlling, and establish the rates to be charged, in the absence of any other agreement to the contrary, although contracts subsequent to the date of the franchise were made for limited periods during the life of the franchise for the same rates as those contained in the franchise. Even had they been at higher rates, they would have modified the franchise to that extent only for the period for which the contracts were made. The making of contracts from time to time was a practical construction that the village was obligated only for water that it used from time to time, the same as a private consumer, and not evidence of an intention wholly to nullify the provisions of the franchise as to rates to be charged.

ASSESSMENT OF BENEFITS NOT A TAX WITHIN THE STATUTE EXEMPTING CITY PROPERTY FROM TAXATION

The Connecticut Supreme Court of Errors holds, Whitmore v. City of Hartford, 114 Atl. 686, that, while an assessment of benefits is an exercise of the taxing power of the state, it is not a tax within the meaning of Connecticut General Statutes, par. 1160, exempting all property belonging to any city from taxation. While it is "in a general sense a tax, it is one of a peculiar nature. It is a local assessment imposed occasionally, as required, upon a limited class of persons interested in a local improvement, who are assumed to be benefited by the improvement to the extent of the assessment." Bridgeport v. New York, etc., R. Co., 36 Conn. 255. They stand apart from the general burdens imposed for state and municipal purposes, and are governed by principles that do not apply to the general levy of taxes. In addition to the common taxation, special assessments demand that special contribution, in consideration of a special benefit, shall be made by the persons who receive it. The demand for the special contribution is justified by the fact that those who are to make it, while they are made to bear the cost of the public work, are supposed to suffer no pecuniary loss thereby, because their property is increased in value to an amount at least equal to the sum they are required to pay.

NEWS OF THE SOCIETIES

Nov. 8—WATERBURY BRANCH. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce Hall. Secretary, J. R. Putnam, 64 Woodside ave.

Nov. 9—BALTIMORE SECTION. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club. Secretary, Prof. A. G. Christie, Johns Hopkins University.

Nov. 9—NEW ENGLAND WATER WORKS ASSOCIATION. American House, Boston, Mass.

Nov. 13-17—AMERICAN CIVIC ASSOCIATION. Chicago, Ill. Headquarters, 905-7 Union Trust bldg., Washington, D. C.

Nov. 14—METROPOLITAN SECTION. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with A. I. E. E., A. I. M. E. and A. S. C. E.

Nov. 14—NEW HAVEN BRANCH. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Mason Laboratory, Yale University. Secretary, Prof. S. W. Dudley, 400 Temple st., New Haven.

Nov. 14—NEW YORK SECTION. AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies bldg., New York City. Sec., G. I. Rhodes, 115 Broadway, New York City.

Nov. 14-16—CITY MANAGERS' ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

Nov. 15—LEVEE AND DRAINAGE CONTRACTORS' ASSOCIATION. St. Louis, Mo.

Nov. 15-18—ATLANTIC DEEP WATERWAYS ASSOCIATION. Savannah, Ga. Headquarters, Real Estate Trust bldg., Philadelphia, Pa.

Nov. 16-18—NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

Nov. 17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Society of Naval Architects and Marine Engineers. New York.

Nov. 17-18—SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS. New York.

Nov. 17—BRIDGEPORT BRANCH. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce.

Nov. 17—TOLEDO SECTION. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Toledo Commerce Club. Secretary, Loring Freed, Atlas Chemical Co.

Nov. 17—WORCESTER SECTION. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Worcester section, A. I. E. E. Secretary, Harry M. Latham, Crompton & Knowles Loom Works.

Nov. 21—CHICAGO SECTION. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Western Engineering Society.

Nov. 22—ATLANTA SECTION. AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Nov. 22—PHILADELPHIA SECTION. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Adelphia Hotel.

Nov. 25—COLORADO SECTION. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel, Denver. Secretary, William Lester, Vulcan Iron Works.

Nov. 28-29—KANSAS CITY SECTION. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Two-day regional meeting. Secretary, Louis Bendit, 517 Finance bldg.

Dec. 1-3—MONTANA IRRIGATION AND DRAINAGE INSTITUTE. Great Falls, Mont.

Dec. 5-9—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual convention. New York City.

Dec. 6-9—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 14th annual meeting. Baltimore, Md.

Dec. 14—NEW YORK SECTION. AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' building, New York City.

Dec., 22-23—KANSAS ENGINEERING SOCIETY. Hutchinson, Kan.

Jan. 4-14—CLEVELAND, OHIO, BUILDING EXPOSITION. Municipal auditorium, Cleveland, Ohio.

Jan. 17-20—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Feb. 12-17—CONFERENCE OF HIGHWAY ENGINEERING. 8th annual conference. University of Michigan, Ann Arbor, Mich.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19—AMERICAN WATER WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

BROOKLYN ENGINEERS' CLUB

The October 27th meeting of this club took the form of a discussion of the proposed "Amendment No. 1" to the constitution of New York state, in which it is proposed to give to all veterans of the recent war preference over all others in civil service appointments. Past Commander Thomas Gannon of the New York state department, Spanish War Veeterans, took the affirmative and James J. Deasy the negative.

On October 29th an inspection trip was made to the new piers being constructed by the city of New York at Stapleton, S. I., where there are twelve large piers and sheds estimated at $18,000,000, affording five miles for wharfage 1,800,000 square feet of pier space. This work, which was begun in 1920, is now practically completed.

The regular meeting of Nov. 3 was Ladies Night, devoted to social pleasures at the Club House, and attended by many members and guests.

OFFICERS NOMINATED FOR AM. SOC. C. E.

The nominating committeee of the Am. Soc. C. E. has selected the following candidates for offices to be filled at the annual election on January 18th: For president, John R. Freeman; for vice-president, C. B. Grunsky and Robert Ridgway; for treasurer, Otis E. Hovey, and for directors, C. M. Holland, J. J. Yates, F. E. Winsor, John N. Chester, A. J. Dyer and W. L. Huber.

INDUSTRIAL RELATIONS CONFERENCE

A conference was held at Harrisburg, Pa., October 24-27, under the auspices of the Department of Labor and Industry, Commonwealth of Pennsylania, Clifford B. Connelley, commissioner.

Preliminary session October 24th: Meeting of the approved boiler inspectors of Pennsylvania.

Monday evening: Address, The Honorable William C. Sproul Governor of Pennsylvania. Address, "The Present Industrial Situation," The Honorable J. J. Davis, Secretary of Labor, Washington, D. C.

Friday: Industrial Co-operation (The Four Factors in Industry), (a) The Employer (speaker to be announced); (b) The Employe, Mr. John A. Voll president, Glass Bottle Blowers' Asso., of United States. (c) The Public, George E. Mallwain, Babson's Statistical Organization. (d) The State, Honorable Edward E. Beidleman, Lieutenant Governor Pennsylvania.

The Foreign Outlook, Dr. Frederick Willson, Reading, Pa.

Women and Children in Industry, (a) Employment of Minors, Miss Mary Anderson, director, Women's Bureau, Bureau, Dept. of Labor, Washington, D. C. (b) Employment of Women and Minors. (c) The Massachusetts Forty-Eight Hour Week vs, the Eight Hour Day, Miss Ethel Johnson, Asst. Commissioner Dept. of Labor and Industries, Massachusetts. (d) Women and Welfare Work.

Tuesday evening 6.00 P. M., Women's Club of Harrisburg, meeting of the representaties of the Women's organizations of Pennsylania.

Stabilizing Industry and Employment, a) Samuel A. Lewisohn, New York. b) Prof. H. G. Moulton, University of Chicago. (

Industrial Waste, (a) Unemployment, L. W. Wallace, Executive Secretary, Federated American Engineering Societies, Washington, D. C. (b) Industrial Disputes, Dr. Wm. Leiserson, Chairman, Board of Arbitration Men's and Boys' Clothing Industry, New York. (c) Accidents and Sickness, Cecil G. Rice, President Western Pennsylvania Division National Safety Council, Pittsburg. (d) Hiring and Firing (Industrial Turnover), Magnus Alexander, Managing Director National Industrial Conference Board, New York. (e) Fire Hazards.

Industrial Education (Education for a Better Job), (a) The Elementary and Secondary Schools, Dr. Wm. Davidson, Supt. of Public Instruction, Pittsburg. (b) The Uniersity or Technical Institution, Dr. John M. Thomas, President, Penna. State College, State College, Pennsylvania. (c) The Plant School. (d) The Labor Union College, Mr. John Philips, 2d Vice-President Penna. Federation of Labor. (e) School of Training of Women Workers (The Bryn Mawr College Experiment), Dean Hilda W. Smith, Bryn Mawr College.

Industrial Waste, The Honorable Herbert Hoover, Secretary of Commerce, Washington, D. C.

Industrial Publicity (a) The Daily Newspaper, J. Easton McKirdy, Pittsburg. (b) The Industrial Plant Magazine. A Ellis Frampton, Hammermill Paper Company, Erie. (c) The Technical Journal, Wm. W. Macon, Editor of "Iron Age." d) The Trade Journal, John Frey, Editor "Moulders' Journal.

Speakeers: Value of the Employe's Magazine, Miss Anna Bezanson, Dept. of Industrial Research, Univeristy of Penna.

Co-operation of the Industrial Editors with the State Department of Labor and Industry, Dr. C. B. Connelley Commissioner.

Medical Supervision in Industry (a) Industrial Medicine as a Factor in Industrial Efficiency. (b) The Maintenance of Community Health Dr. Edward Martin, Commissioner of Health, Harrisburg. (c) The Rehabilitation of the Industrial Cripple (illustrated by lantern slides and motion pictures), General Lewis T. Bryant, New Jersey Commissioner of Labor.

(Continued on page 370)

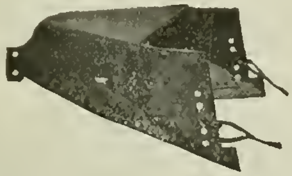
New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

POWER DRAG SCRAPER

The bottomless steel plate power drag scraper manufactured by L. T. Green is made in 8 sizes of ½ to 5 cubic yards capacity, weighing from 400 to 2,000 pounds each, and developing a pull of from 3,000 to 19,000 pounds on the load line and requiring from 12 to 150 h. p. of steam, gasoline or electric h. p.

The longer the haul, the larger sized scraper is suitable, and the corresponding capacities in one 10-hour day with a line speed of 250 feet per minute on the load line and 600 feet per minute on the return line vary from 350 to 117 cubic yards for a ½-yard scraper with 100 to 300-feet average haul, or for a 5-yard scraper the capacity varies from 3,500 cubic yards for a 100-foot haul to 700 cubic yards for a 500-foot haul.



POWER DRAG SCRAPER

The scraper is operated by any standard 2-drum hoisting engine and will dig and convey to any desired point without expensive overhead equipment. It will load wagons, trucks or cars; deliver materials to belt conveyors or bucket elevators; handle storage, strip over burden from pit, and successfully handle any kind of material from soft mud to hard clay. It is claimed to be the most economical device for handling hillside deposits and in many cases is adaptable for reclaiming material under water. The first cost and operating cost are low and the manufacturers offer to send the scraper on trial where there are hoists and other equipment competent to handle it.

The standard equipment necessary for the operation of a 1-yard power drag scraper at a reach of 350 feet from hoist, consists of 300 feet of 6 x 19 plow steel wire rope, four wire blocks with grease cups, 84 cable clips, 6 shackles, one 75-foot bridle cable, three 60-foot guy cables, five 25-foot cables for dead men slings and one 2-drum friction hoist.

P & H EXCAVATOR CRANE SHOVEL ATTACHMENT

The Pawling & Harnischfeger Co. have just put on the market a new shovel attachment, adapted for use with their No. 205 or 206 excavator crane, which, when substituted for the standard boom of this machine, effects great economy and convenience and enables the one machine to be used for shovel excavating, dragline excavating, backfilling and all-around material handling with grab buckets, scrapers, eletromagnets, sling chains or grapples. In addition, the skimmer boom may be employed for some kinds of road and street work.

The Shovel Attachment is so designed as to make it possible to interchange it with the standard boom of the 205 or 206 Excavator Crane with but few changes necessary.

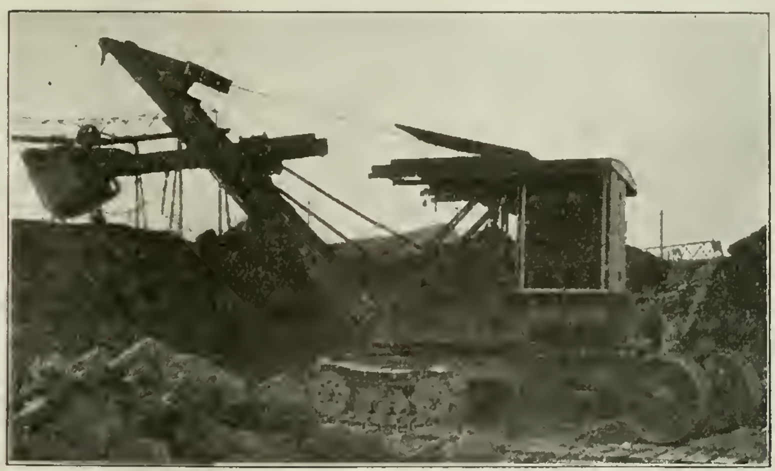
With the new attachment one machine may, therefore, be used for allround material handling, drag-line excavating, shovel excavating, and for back filling with grab bucket, Page bucket, scraper, electro magnet, sling chains, and grapples. In addition to this a skimmer boom may be employed for some kinds of road and street work.

The box section boom is constructed of rerolled structural steel plates, so designed that all the rivets are driven from the outside and readily accessible. The boom foot is a single annealed steel casting, securely riveted to the structural members.

The shipper shaft is a high carbon steel forging with annealed cast steel, bronze bushed bearings and saddle blocks provided with renewable cast iron slide plates.

The ½-yard dipper has a steel plate shell, front, lip, and door; annealed cast steel back, forged teeth with hardened points, and forged hinges. The cast steel dipper handle, designed to straddle the boom, consists of two members each having an oak core, armored with steel plates on all four sides. The dipper handle racks are manganese steel castings. All pin joints on both dipper and handle are bushed with hardened steel bushings.

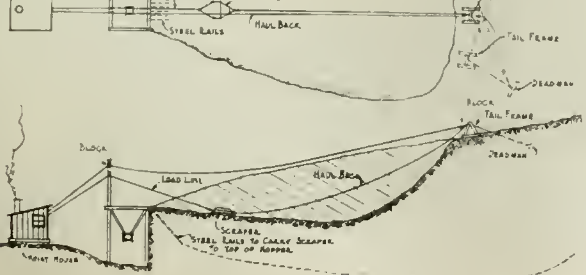
The Shovel Attachment is operated by standard levers on the machine, with the exception of an additional brake attachment to one of the brake treadles.



GENERAL CONSTRUCTION SHOVEL ATTACHMENT INSTALLED ON EXCAVATOR CRANE

This attachment can be quickly removed in case it is desired to re-convert the machine into a dragline or for operation with a clamshell bucket.

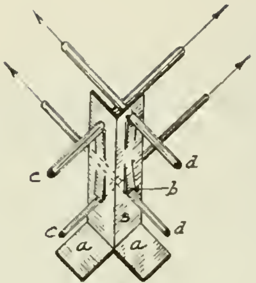
The Shovel Attachment conforms to the standard of steam shovel practice, and will dig continuously and at high speed, any material which can be handled by a steam shovel of similar weight.



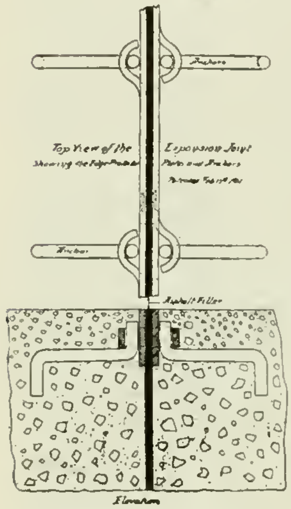
TYPICAL INSTALLATION FOR EXCAVATING FROM HILLSIDE AND LOADING CARS, TRUCKS, CONVEYOR OR ELEVATOR

REINFORCED CONCRETE PAVEMENT STOOLS AND JOINTS

The Thomas Steel Reinforcement Co. has issued a 48-page book, describing the construction of the "Thomas System" of reinforced concrete pavements that do not crack, with special attention to the little Hercules stool



REINFORCEMENT STOOL



EXPANSION JOINT PROTECTION AND ANCHORAGE

for supporting and automatically gripping the reinforcement rods with "Sure Anchor" edge protection for expansion joints.

The stool is made from short lengths of No. 6 angle bars, having the flanges split apart and bent at right angles to form a stable base, and holes and tongues punched in both vertical flanges so that the reinforcement bars may be inserted and then rigidly held in place by closing the tongues against them, an operation that is positive, efficient, and performed with great rapidity and simplicity by single hammer blows.

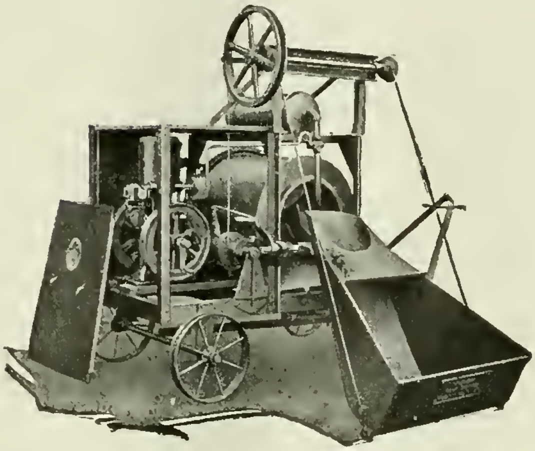
The expansion joints of any required type are protected by a pair of special flat steel bars on opposite sides of their upper edges. These bars have spring tongues punched in them to engage anchor rods that can be instantly connected to them without the use of special tools and will secure them firmly in position under all conditions of the joints.

The manufacturers offer tool boxes containing gas pipe forms so that any size reinforcing frame can be made to fit any width roadway with proper tools to pinch the bars in the stools, and will send experienced men to get first jobs started, and break in men to make the frames at the bare cost of time and expenses.

RANSOME BANTAM MIXER

The number 4-S Ransome Improved Bantam Mixer has all of the general advantages of the original Bantam and some special features that make it particularly adapted for small foundations, culverts, and sidewalk building, for mortar mixing and similar classes of work. It is a sturdy, light, portable machine providing thorough mixing action wth fast discharge. The driving gears are of the Maag type that are very strong with a long line of contact that provide a maximum of rolling contact and minimum of sliding contact. have an easy action and an enlarged surface for resisting wear.

All castings are made from aluminum patterns, insuring smoothness and accuracy and interchangeability of the parts. The support of the drum is special in that two of the rollers are very close together providing substantially a three-point suspension that insures perfect bearing over all irregularities. The machine is equipped with a fixed chute or side loader, operated by its 3 h. p. engine. It weighs 3,650 pounds, has a housing, removable on three sides and requires about three pints of gasoline per hour for its operation.



4-S RANSOME IMPROVED BANTAM MIXER

INDUSTRIAL NOTES

The Albert Grauer Co., manufacturers and contractors for sidewalks, lights, mastic floors and skylights, has opened offices at the Builders' Exchange in Cleveland, Ohio.

The Holt Mfg. Co. of Peoria, Ill., has appointed W. A. Bickel as district manager in charge of the consolidated territory of Iowa and Nebraska.

The Cortland Machinery & Equipment Co., Inc., has been organized with offices in New York City, to specialize in the sale of saw mills, logging tools, power machinery, etc.

The Chain Belt Co., Elyria, Ohio, has opened offices in Buffalo, N. Y., with T. E. Crocker as district manager.

The Wisconsin Construction Co., general contractors and engineers, has changed its name to the Paul C. Kroeck Co.

S. P. Rees, formerly with the Pittsburgh Filter & Engineering Company of Pittsburgh, Pa., has been made manager of the Municipal Filtration Department of the International Filter Co., First National Bank Bldg., Chicago.

RANSOME COMPANY'S NEW PLANT

On Oct. 6 the Ransome Concrete Machinery Co. of Dunellen N. J., broke ground for an addition to their present plant which will increase their manufacturing space 54 per cent.

The 53 x 320-ft. new building contains huge electric cranes running the entire length of the factory and capable of handling any but the very largest concrete mixers made by the Ransome Company. The machine shop and erecting floors will be equipped with the most modern machinery including portable air and electric equipment.

(Continued from page 368)

Workmen's Compensation (a) Progress in Compensation The Honorable Robert E. Lee, Chairman, Workmen's Compensation Board, Maryland, and President of the International Workman's Compensation Boards and Commissions. (b) Compensation Legislation, John B. Andrews, Secretary, American Association for Labor Legislation. (c) Interstate Commerce and the Supreme Court of the United States, The Honorable Harry A. Mackey, Chairman Pennsyvania Workmen's Compensation Board.

SAFETY EXHIBITS

An Industrial Welfare Exhibit was held for the display of material relating to industrial efficiency, such as fire prevention and protection, safety devces, illumination, first aid, health, hygiene, welfare, etc.

The Museum of Safety Appliances of the Department of Labor and Industry was opened to the public for the first time. This exhbit included over three hundred safety appliances of all types that hae been approved by the State Industrial Board.

NEW ENGLAND WATER WORKS ASSOCIATION

The November meeting of this Association will be held at the American House, 56 Hanover St., Boston. Wednesday, November 9, 1921.

Programme

11:00 A. M.—Meeting of the Executive Committee at the Headquarters, Tremont Temple.

1:00 P. M.—Lunch will be served at the American House.

2:00 P. M.—Paper: "Steam Boilers," by F. W. Dean, Boston, Mass. Illustrated). Topical Discussion, Frank J. Gifford, Secretary, Dedham, Mass.

PERSONALS

Southgate, W. W., city engineer, and Capt. George Reyer, superintendent of water works of Nashville, Tenn., have become members of the Nashville board of public works.

Dormant, Francis L., city engineer of Houston, died on October 12th

Anderson, G. B., has been transferred by the department of public works from Ottawa to Sault Ste. Marie, Ont.

Sylvster, S. deputy minister of public works, Quebec has resigned after holding the position for twenty years.

Cappelen, F. W., city engineer of Minneapolis, Minn., died on October 16th.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 NOVEMBER 12, 1921 No. 20

New Pavements of Danbury, Connecticut

Old granite blocks napped and reclipped and relaid on several streets, sheet asphalt on Main street, and roadways widened and curbs straightened. A total of 35,000 square yards laid, using local sand and stone blocks from the streets paved.

By C. D. Pollock*

Danbury, Conn., had considered new pavements for its principal streets for many years but did not get beyond this stage until the early part of 1919, when William C. Gilbert was elected mayor together with a council and board of aldermen who were in heartiest sympathy with Mayor Gilbert's plan to give the city first-class modern pavements.

The first step taken was the appointment of a special paving committee composed of members of the city council and board of aldermen, together with prominent citizens and business men and the mayor. The chairman of this committee was former State Senator Charles S. Peck, who had long been an advocate of replacing the old pavements of Danbury with modern ones. Permission was obtained from the legislature, which was then in session, to issue bonds to the amount of $100,000 for repaving, and the bonds, paying 5 per cent, were taken by the local banks of Danbury, which paid a small premium. The writer was retained as consulting engineer, and arranged with the city engineer, Charles O. Brown, to make the surveys. These having been obtained from Mr. Brown, the plans were made and the specifications drawn for the repaving of several blocks of Main street, and two other streets, with sheet asphalt pavements on 5-inch Portland cement concrete foundation; and Wooster square and four streets with napped and reclipped granite block pavement on a concrete foundation.

The city of Danbury was paved with the old 8-inch depth granite blocks which had seen from

SHEET ASPHALT ON MAIN STREET, SHOWING STEP ALONG CURB AT RIGHT
Also shows new lighting system installed at the same time as paving.

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*Consulting engineer, New York City.

35 to 40 years' service on Main street and two of the other streets. The balance of the streets were paved with Belgian blocks which were second-hand when laid many years ago. As there was some question as to there being sufficient granite blocks to pave the entire area after they were recut, it was decided to pave Main street with sheet asphalt, as it is a wide street and the traffic is therefore distributed. This insured sufficient blocks to repave the other streets, which were narrow in comparison and carried heavy loads to and from large hat factories, etc.

In deciding upon the kind of pavement to be used, the fact that the city had a considerable area paved with old granite blocks which were capable of being used to advantage after recutting was an important factor. It must be remembered that at this time there was a great shortage of freight cars and numerous embargoes were in force, and consequently it was very important that local materials be utilized wherever possible. As these old granite pavements were practically equivalent to having a quarry in the center of the city, there was a big advantage in recutting and using these blocks as far as possible. As Main street has a wide roadway and as the high school, several churches and the city hall are located on this street, sheet asphalt was selected for this location.

WIDENING AND STRAIGHTENING ROADWAY

The work was advertised and bids were received on July 25, 1919, the low bidder was C. W. Blakeslee & Sons, of New Haven, and the contract was awarded to this firm at $2.16 per square yard for sheet asphalt pavement 3 inches deep, with maintenance for 5 years. The napped and reclipped granite block pavement was let at $2.33 a square yard in the city area and $2.40 a square yard in the railway area. The price for the concrete foundation was $8.50 a cubic yard in the city's area and $8.90 per cubic yard in the tracks.

The street railway company was in the hands of a receiver and this caused a serious complication at the start, as the receiver had very little money that he could use in relaying the tracks, and nothing for repaving. It was finally arranged that the city would pave the tracks and then endeavor to collect from the receiver later. The receiver relaid the old rails on Main and White streets, and put in new ties where necessary. This was a slow and tedious job, as the old rails were in bad shape. However, a fairly good track was obtained considering the materials that were available.

The contractor began work on White street at the New Haven Railroad tracks in August, 1919, and completed the granite pavement on this street that fall. He erected his asphalt plant and laid a portion of the asphalt on Main street, when cold weather set in and it was necessary to shut down this work for the winter. The concrete had been completed on one side of the street, and traffic was allowed to pass over this concrete all winter. Much of this concrete was laid after cold weather had set in, but as care was taken to see that there was no frost in the subgrade, this concrete was first-class in the spring. Snow and ice protected the surface from the abrasion of traffic until it was set up hard and no repairs were required when it was cleaned off in the Spring of 1920 perparatory to laying the asphalt surface.

At the time the contract was let it was hoped that the entire work would be completed during the fall of 1919, but as the season was an unusually wet one, delaying the track work of the railway company, this with the scarcity of labor caused a slowing up all along the line. The contractor was obliged to work with a small force as he followed the track gang and nature hindered the track work.

However, this slow progress was not an unmixed blessing, as during the winter it was decided to abandon the tracks in Elm, River and Rose streets and the city authorities also arranged for widening and straightening the roadway of Elm street, which is a continuation of White street leading from the New York, New Haven and Hartford R. R. station westerly to the hat factory section.

The contract called for constructing a step along the west side of Main street for a block south of Wooster square, but later it was decided to widen and straighten the roadway on the west side of Main street for nearly half of the length of the improvement. As this sidewalk was considerably higher than the east walk it was necessary to place a step for nearly the entire length of the widening and a second step for a short distance at Wooster square.

In connection with the widening of Elm street, it was necessary to build two retaining walls and to widen the roadway at its crossing over Still river and also to construct a sidewalk on the south side at this point. The abutments were rebuilt and extended and a reinforced concrete slab was placed over the river, using old railroad rails and reinforcing wire mesh.

For the most part the subsoil was good, but it was known that there was quicksand at the southerly end of Main street in front of the high school, which condition the contractor took care of by providing for an open jointed tile drain with laterals at close intervals.

In the sheet asphalt pavements a stretcher course of granite blocks was bedded in the concrete along each side of each rail of the street railway tracks. There was some movement of the rails under the car traffic and this precaution was taken to protect the edges of the asphalt in the tracks, as the committee desired to have asphalt laid in the tracks on Main street rather than napped granite so as to obtain a uniform appearance. This method of construction has proved successful so far.

The concrete foundation was the usual 1:3:6 mixture of Portland cement concrete and was laid five inches deep.

The best grade of napped and reclipped granite block pavement was specified and obtained; the dimensions being 6 to 12 inches in length, 3½ to 4½ inches in width and 4¾ to 5¼ inches in depth. The dressing called for was the same as that for new standard block, and was practically what is known as Class "A" in the block maker's bill of prices. During the progress of the work it was found that many more of the city's old blocks could be utilized by allowing blocks to be made 5 inches in width and this was permitted, but the contractor was required to pile these wider blocks separately and lay them by themselves. As a grout filler was used, this worked out very satisfactorily and a first-class pavement was the result.

In calling for bids for asphalt, prices were obtained on both so-called natural and oil asphalts. The committee selected Berumdez and this was used in the asphalt pavements.

A very good local sand was obtained for the asphalt mixture and the cement grout in the two pavements. It was well graded and an average of 34 per cent passed the 80 mesh and was retained on the 200 mesh sieve. As the sand had a good proportion of fine particles, an average of 11.2 per cent of bitumen was used with a penetration of 56 at 77 degrees Fahrenheit for the asphalt cement.

The entire paving and widening work was completed before the close of the working season of 1920 at a total cost, including the engineering, of $147,056, being $784 under the estimated cost; $100,000 of this was raised by bond issue and the balance was appropriated from the current tax levy.

A total of 35,000 square yards of pavement was laid, divided about evenly between sheet asphalt and napped granite. This took care of the principal business streets of Danbury and now that city is as well paved as any city in Connecticut. This contract was let at an opportune time and carried out within the original estimate in spite of rising labor and material prices. The city made large appropriations from the tax levy, but even with these it was able to reduce the tax rate

TYPE OF OLD GRANITE BLOCK PAVEMENT ON MAIN STREET rather than increase it. The inspection was done by experienced construction engineers who knew what was wanted and got it. The contractor co-operated thoroughly in securing good construction and there was complete co-operation by all the city officials, which was the secret of the good results obtained.

In addition to laying the best of modern pavements, the city at the same time installed a new system of street lighting, using ornamental posts. The accompanying view of Main street at night, furnished through the courtesy of Photographer Baisley, of Danbury, shows the new system of lighting on Main street as well as the new pavement and the step in the westerly sidewalk.

Since the new pavements were laid the city has inaugurated the patrol system of cleaning the pavements and Superintendent Raymond and the men take great pride in keeping the streets really clean.

At the end of the first year after the completion of this work there was no maintenance required. Danbury is justly proud of her new pavements.

Dewatering Sewage Sludge*

By T. Chalkey Hatton, M. Am. Soc. C. E.†

Value of sludge as a fertilizer, difficulty of disposing of it otherwise, and some European and American experiences in such use. Methods of dewatering for use.

A scientist connected with the United States Agricultural Department published the statement that the people of the United States were wasting $250,000,000 per year through failure to utilize the fertilizing value present in the sewage produced by cities exceeding 10,000 population.

I remember being startled at the time by such a statement but this was before the war when we thought in millions rather than billions. However, I did make some extremely rough computations to check up his statement and am giving them to you just as they appear in my notes made in 1914 when I was just beginning to wonder what disposition the city of Milwaukee was going to make of the sludge to be produced from its proposed sewage disposal plant which I had been engaged to design.

Cities of over 10,000 population in U. S. . .	755
Total population in such cities.	45,000,000
Gallons of domestic and industrial liquid wastes per day, at 100 gallons per capita	4,500,000,000
Tons of suspended solids in wastes.	3,150,000

Say, 75 per cent can be removed by plain sedimentation or 2,362,500 tons, that the sludge contains 2 per cent nitrogen as ammonia and that its value as low grade fertilizer is $2.50 per unit or $5.00 per ton. Then the total value of the waste material would approximate twelve million dollars annually.

How the scientific chap got at his result I cannot say, but you can see how I got at mine, and can pick the method to pieces if you please; still you will reach the conclusion that there was something in the statement well worth our earnest thoughts.

I know the answer that many, in fact, most of our leading sewage disposal engineers will make, for I have heard them make it: Why conserve the fertilizing value in sewage when it costs more to do so than you can get for it?

From an industrial engineer's viewpoint, such an inquiry would call for but one answer, as his client must be shown where and how he is going to get back in profits the dollar fifty when he spends the dollar, but to the municipal engineer, who is supposed to be advising a client composed of a great number of people whose profits are represented rather by its health and comfort than by dollars, it is more difficult to prove that it is not well worth to such a client the extra money the conservation of the fertilizing value in sewage would cost.

Adjacent to every city of 10,000 inhabitants there is a community of agriculturists which carries on intensified farming and small fruit and berry growing and which needs for the purpose a fertilizer; the cheaper the fertilizer the richer the community becomes. What may enrich the outer community affects the inner community correspondingly. Thus a cheap fertilizer supplied in usable form to the small farmer and trucker adjacent to a city will swell the bank deposits and reduce the cost of produce even though its production may increase the tax rate of those assuming it.

It may be that I am dreaming and my dreams magnify the value to the agriculturist of the average sludge produced from sewage. If I am, it is because I am not too young to recall how poudrette companies of years ago flourished in those cities where cesspools were in common use and how anxious the little farmer was to stand in well with such companies even though the product furnished was most disgusting to handle; my dreams may be the result of what I have seen accomplished by the small farmer by using tankage from garbage reduction plants; or from those farmers in Germany who buy and use the partially dewatered sludges from the nearby sewage disposal plants.

During a recent trip through Germany, I visited several sewage disposal plants where plain sedimentation was the sole process used for sewage purification and where all the sludge was sold to the small farmer in the neighborhood for a sum much below what it cost to dewater it, and yet I didn't hear an engineer express the opinion to the effect that such a method of disposal didn't pay; on the contrary, everyone expressed the opinion that if the sludge could be dewatered just enough to make it easily handled, it was the best and only way to get rid of a nuisance which he had found by experience would continue to grow until it became a nuisance to the whole community.

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†Chief Engineer, Milwaukee Sewerage Commission.

*Paper before American Society for Municipal Improvements

During a recent visit to some of the most important sewage disposal plants in England, I found practically the same methods of sludge disposal being carried out as I witnessed in 1907. English engineers seem to have made little or no progress in eliminating the sludge nuisance which is apparent in all of their plants where the sludge is not dumped in the sea. Several of the leading engineers expressed to me that the time had come when this matter must be given far more study and that a better way of meeting the almost overwhelming nuisance must be found.

England has been building and operating sewage disposal plants much longer than any other country. Its tendency is to follow along well-known lines and as one engineer expressed it to me: "To get both feet firmly planted before taking one from the ground, but that the time had come when conditions demanded that the foot be lifted." Dr. Calvert, who is chief investigator of sewage disposal plants for the National government, told me that as the municipalities got upon their feet financially, they would be required to carry out more sanitary methods of disposing of their sewage sludges.

IMPORTANCE OF SEWAGE SLUDGE PROBLEM

All of the foregoing is explanatory of the following statement: That the time has come when American engineers should give more consideration and study to the sanitary disposition of sewage sludges regardless of the cost, or the municipalities operating disposal plants will find as their population, and the population in their immediate neighborhood increases, their sewage disposal plants will become as unpopular as they now are in England.

Assuming for the moment that it is desirable to conserve, so far as practicable, the fertilizing values in sewage sludges, there is one question which must be considered: What is the local market likely to be for the sludge or will it be necessary to secure a market where transportation becomes a serious item.

If the local market can take all the sludge produced, it can be easily transported in bulk in wagons or trucks, and the dewatering need not be carried below 75 per cent moisture; if the sludge must be transported upon cars, then it must be dewatered to a much lower moisture—probably to 10 per cent—when it can be more profitably used as a base for a high-grade fertilizer, although the city of Bradford, England, reduces the moisture in its sludge to 25 per cent by pressing alone, ships it in bulk in cars and finds a ready market.

If it is to be dewatered to about 75 per cent or a little less, it can be so done by either drying on sand or stone beds, pressing through filter presses or centrifuging; if it is to be dewatered to 10 per cent moisture, it is more economical to take out the larger volume of water by one of the three methods above mentioned and the balance by some type of heat dryer.

SOME COST FIGURES

The most economical method of dewatering to 75 per cent moisture largely depends upon the character of the sludge, the climatic conditions and the local nuisances likely to arise from outside drying. An illustration of the probable cost of dewatering by drying on sand or stone beds is given in N. Adelbert Brown's paper presented at this meeting of the society,* to wit: From 33 to 36 cents per cubic yard, exclusive of overheads, the material being sold to the neighboring farmers for from 25 to 37½ cents per cubic yard

The cost of dewatering by pressing has been determined after many years of operating the Worcester and Providence plants where the cost runs from 79 cents to $1.25 per cubic yard, exclusive of overhead.

The cost of centrifuging may be safely taken from the Herrenhausen disposal plant, which treats the sewage from Hanover-Linden, and where the centrifuge has been successfully used for several years for dewatering the sludge from plain sedimentation tanks without the use of lime or other precipitant. Converting the cost of German labor to the cost of American labor, the cost of centrifuging such sludge is 12 cents per cubic yard and the moisture content in the resultant sludge is about 70 per cent.

The cost of dewatering from 75 per cent or 70 per cent to 10 per cent moisture can easily be estimated as the process is not unlike the removal of moisture by heat dryers from many substances used in the industries, and manufacturers of the modern direct-indirect heat dryers will guarantee the removal of 10 pounds of water per pound of combustible consumed; or 6,000 pounds of water per hour can be removed from sludge by such a dryer, say 84 inches by 60 feet long.

If the amount of nitrogen contained in the sludge warrants the cost of transporting it by rail or boat a considerable distance, the cost of reducing it to 10 per cent moisture is justified, otherwise a market not exceeding from five to ten miles haul should be found for it and the limit of moisture reduced should be from 65 to 75 per cent, in which condition it can be easily transported and handled by the farmer, trucker and fruit grower.

An illustration of what can be done towards marketing low-grade sewage sludge may be given in Baltimore where for years a contract was carried out by which the contractor took the partially dried sludge from the sewage plant, dried it to 10 per cent moisture without cost to the city, and, when the nitrogen content of the sludge was 2 per cent or more, he paid the city 80 cents a unit therefor, which not only brought the city a profit but helped materially to solve the sludge problem.

What Baltimore seems to be up against is to get some practicable method of reducing the mois ture in its sludge to 70 or 75 per cent and centrifuging may be the solution of the problem.

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*See "Public Works" for November 5.

SLUDGE AS FERTILIZER

Another illustration of what can be done towards conserving the value in sewage sludges is set forth in Mr. Brown's paper on sludge disposal at Rochester and previously alluded to in this paper. Mr. Brown found that by a little education promulgated around the neighboring agricultural communities, such a ready market was found that he was warranted in increasing the selling price 50 per cent, and I predict that in a short time he will be able to increase this price and dispose of all the sludge produced. This is just what happened in Germany and it will happen here if proper educational methods are pursued and the sludge produced in usable form.

The sludge nuisance can and should be eliminated from all sewage disposal plants and until this is done in a sanitary manner, sewage disposal will never be the success in the public eye which water purification has reached. Engineers should recognize that to dispose of this highly putrefactive substance by dumping it upon ground and there letting it rot is not the final solution of the question even though the cost may be small; such a disposition will sooner or later prove a nuisance to any community which it will not stand and the engineer will come in for his share of condemnation.

If there is a value in the sludge—and there is in all sludges—it should be conserved so far as local conditions warrant even though the cost is greater than the direct monetary returns. This value should be better known by those producing it as well as to those who might profitably use it. The best medium to determine this value and to transmit such determinations to the public is the Bureau of Soils of the United States Agricultural Department, which should, in my opinion, thoroughly investigate the whole subject, making growing tests from all kinds of sewage sludges and publishing the records so broadly that those in need of a low-grade fertilizer may know what value it may be to them.

The Agricultural Department of the Imperial German Government, prior to the war, made exhaustive studies of this subject, with the result that all sewage sludges from the principal sewage works of Germany are in such demand by the neighboring farmers that none is apparent about any of the works there which I recently visited. In fact, so far as I was able to observe, Germany had no sludge nuisance like England and America and what the Germans have done we can do equally as well.

I would therefore strongly urge this society to appoint a special committee to interest the Bureau of Soils of the United States and co-operate with it in bringing about an immediate investigation of the disposal of sludge as a fertilizer.*

Grand Rapids Needs Sewerage Extensions

Grand Rapids, Mich., has about 250 miles of sewers, many of them more than 50 years old. The sewage is conveyed to the river through four main outlets, two on the west side of the river and two on the east. These are combined sewers and most of the old ones were built to serve areas smaller than those now draining to them and with less impervious streets and fewer roofed areas. The consequence is that the trunk sewers are flooded for hours at a time following ordinary storms and are absolutely inadequate to care for excessive downpours.

It is proposed that a sanitary engineer be called in to make a study of the entire situation and propose plans for relieving it as soon as possible.

Developing North Jersey Water Supplies

Some years ago the legislature of New Jersey gave into the control of a commission known as the North Jersey District Supply Commission the general apportionment of the available water supply in northern New Jersey to the various communities therein in proportion to their needs. This at least was the purpose in view in the appointment of the commission. There have been changes in the constitution and power of the commission since then, but the general idea and purpose remain the same.

One of the latest moves of this commission was to undertake the construction of the Wanaque dam for making available the Wanaque river as a supply for Newark and a number of the neighboring communities. Unfortunately only Newark could be interested in the project to the point of actual investment of funds, and last year the commission undertook the construction of the dam with Newark alone paying the bills therefor; the understanding being that if other communities desired to come in later and benefit by the Wanaque supply, they could do so by paying their proportionate share of the cost of developing it.

Newark officials recently have expressed themselves as feeling that it is unjust to ask that city to stand the entire overhead costs of the state commission as the builder of a dam which is intended for Newark alone, while Newark itself has an organization and engineers competent to undertake the construction directly and thus relieve itself of the cost of the commission. The city commission claims that the state commission is extravagant; that the cost of the development of the Wanaque will be excessive, exceeding the contract price by several million dollars; and that Newark does not need the development of the full capacity of the supply and therefore should not be asked to pay for it under the possibility that it might some time be reimbursed for that proportion of the development which it does not require.

If, however, the state commission steps out and turns the entire project over to Newark, it would seem to nullify the entire purpose of the commission and surrender to Newark a supply confessedly larger than that city needs but with no certainty that other communities, when they may desire to avail themselves of this supply, will be able to do so under favorable terms, if at all.

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*The sewerage committee of the society was instructed to take such action.

Newark claims that it is as much entitled to individual development of the Wanaque as Bayonne would be to development of the Ramapo watershed as a municipal enterprise, which latter it was assumed would probably be permitted by the State Board of Conservation and Development, which latter board has been charged with the general control of the water supplies. the North Jersey District Water Supply Commission acting more in the capacity of contracting agents.

There would seem to be some justice in the contention of the Newark officials, but on the other hand it would be extremely unfortunate if any action were taken which would serve as a step backward toward the conditions prior to the creation of the state board; when there was a scramble between private companies and municipalities throughout the state to obtain control of all of the watersheds which could possibly be made available for furnishing public supplies.

American Society for Municipal Improvements*

Conclusion of description of papers and discussions at the twenty-seventh annual convention in Baltimore

On Wednesday evening the first business was the election of officers, and this resulted as has already been stated.

Secretary Brown then read Milton J. Ruark's paper entitled "Miscellaneous Problems Connected with the Design and Maintenance of Sewerage Systems," an abstract of which will be published in Public Works. Pictures of the public comfort station of Allentown were then shown upon the screen by H. F. Bascom, city engineer of that city and chairman of the sub-committee on public comfort stations, following which there was some discussion and questions asked concerning such stations. The report of Mr. Bascom's committee had been published in the advance papers and in it was described the standard public comfort station sign which has already been adopted by at least one state and several smaller political units, and a motion that the A. S. M. I. approve of this and recommend its use as a standard sign was adopted.

At this point the matter of place of meeting was considered but as the committee to whom this had been referred was not ready to report, the subject was referred back to it and postponed until the following day.

Nelson P. Lewis, as chairman of the sub-committee on local sub-divisions under the general committee on city planning, read a characteristically informative paper on "Local Sub-divisions." Reference was made to the control which many cities have over planning of sub-divisions and Rochester, N. Y., was given the credit of having the most complete control of any city in the country. Of the other sub-committees, the report of that on Zoning, by Joseph W. Shirley, was read in abstract and that on Park Systems and Open Spaces was read by the chairman, John M. Rice, in which he outlined a four-year program to be followed by that sub-committee, one feature or group of features to be given exclusive consideration at each convention, and suggested playgrounds as the subject for 1922. With the presenting by Jefferson C. Grinnalds of an abstract of his paper entitled "The Advantages of a Topographical Map in City Planning," in which he described Baltimore's topographical map and exhibited blue prints of many sections of it, the Wednesday evening's session was concluded.

THURSDAY'S SESSIONS

Thursday morning's session began with a paper by C. J. Van Etta, describing the method employed by him in Milwaukee during the past nine years for using old asphalt paving in making patches. There was a brief discussion of this paper and the reports of the committees on street paving were then presented.

In the report of the general committee on Street Paving and Street Design, William A. Howell presented a number of statistics concerning paving work done throughout the country during the past year. The other reports were quite brief and two or three of them commented upon the fact that subjects assigned to the several sub-committees seemed to overlap each other and also those being dealt with by other committees; the chairman of the sub-committee on Street Railway Construction, for instance, being unable to determine the line between the subject matter of his committee and that of the committee on Street Railway Pavements.

Nathan L. Smith's paper on "Granite Block Repaving in Baltimore" was followed by E. E. Butterfield, who showed upon the screen the present condition of pavements in Queen's borough which had been described before the society last year, these including dirt roads treated with ashes and asphalt mixed, alternating rows of stone block and oak wedges, etc. This paper will be abstracted in Public Works. Mr. A. C. Smith then described the Managnan-Sucher process for preserving and transforming wood, which was recommended for wood paving blocks.

Following this, Major Whitman, member of the Public Service Commission of Maryland, presented an abstract of his paper entitled "The Relations between Public Service Commissions and Municipalities," which was discussed at some length by Messrs. Mullen, Howard, Wagner, Sprague, Bascom, Macallum and others. Several of the members were inclined to disagree with Major Whitman's stand in defense of the street railways and in condemning the use of unlicensed jitneys in competition with them. His opinion was that unlicensed jitneys on unspecified routes should not be permitted and that licensed busses for regular routes should be used as feeders to trolleys and not direct competitors, and that where busses were

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*Continued from page 355

needed to supplement trolley service which was unsatisfactory, the trolley companies themselves should be required or asked to provide the bus service. In some cases unrestricted jitney competition had driven the street railway companies out of business, to the great disadvantage of the citizens.

Papers on experimental wood block in Minneapolis, describing inspections made by the Forest Products Laboratory of an experimental pavement built about fifteen years ago in Minneapolis; and a paper on "Street Designs" by P. L. Brockway, were read by title, the authors not being present. A. E. Christhilf, highway engineer of Baltimore, read a paper entitled "Minor Repairs to Sheet Asphalt Paving," in which he expressed a desire that some apparatus be designed for keeping hot several hundred pounds of asphalt paving mixture, to be drawn from place to place in making minor repairs.

In the evening Prevost Hubbard, of the Asphalt Association, presented his paper on "Co-operative Investigation by the United States Bureau of Public Roads Upon the Cause and Correction of Shoving of Asphalt Pavements," in discussing which Mr. Dow stated that an investigation made by him some time ago showed that 80 per cent of such shoving was caused by moisture on top of the concrete base, which had probably been drawn up through the base by capillary attraction.

Major George H. Norton's paper entitled "The Economical Extent of Pavement Repairs and Maintenance" had been published in the advance papers and several discussions and criticisms of it had been received by him by mail, and in reply to these he explained further, by means of diagrams on the screen, his method of calculating at what point repairing an asphalt pavement ceased to be economical.

George Cobb, of Baltimore, in a paper entitled "Plant Inspection of Paving Material," urged that all paving material be inspected at its source, both in justice to the contractor and in order to avoid long delays while new material was being sent to replace it.

Herbert Spencer, of the Standard Oil Co. of New Jersey, then read a long and comprehensive paper describing the manufacture of oil asphalts. Charles E. Murphy, of the Texas Co., read a paper in which he brought out "the real value of highway literature."

The reports of the committees on specifications were then taken up in order. That of H. H. Smith, chairman of the committee on sheet asphalt pavements, which had been published in the advance papers, was accepted. Linn White presented the report of the committee on bituminous macadam, bituminous concrete and asphalt block pavements, recommending some changes in the specifications for bituminous concrete, no changes in those for mituminous macadam or asphalt block, and the dropping of specifications for bituminous concrete using "run of crusher" and specifications for bitulithic. The dropping of the former of these two was opposed by Professor Blanchard, and after considerable discussion the matter was referred back to the committee for further consideration.

The reports of the committees on broken stone and gravel roads, on brick pavements, on cement concrete pavements, on stone block pavements, and wood block pavements, which, with the exception of that for brick pavements, were quite brief, were accepted by the society. The committee on Brick Paving Specifications presented a complete revision of the specifications, making some changes, chiefly to the effect of providing for hillside brick, wire-cut bricks and in general five types of bricks in place of the one type in the previous specifications; also providing for three rattler test results to be used in connection with heavy, medium and light traffic, respectively, together with some other changes and rearrangement of the specifications.

The committee on sewers, W. W. Horner, chairman, reported a difference of opinion in the committee concerning the matter of measurement of sewers and classification of excavated material, one of the members believing that boulders should not be paid for in addition to the regular price for earth excavation; another point of dispute being whether excavation should be paid for by the lineal foot of trench or by the cubic yard.

Reports of the committees on Sub-grade and Foundations, Frederick A. Reimer, chairman; on Street Railway Pavements, including track construction, Charles E. DeLeuw, chairman, and that on Standard Tests for Bituminous Materials, Francis P. Smith, chairman, had been published in the advance papers and were read by title, additional matter, however, being submitted in connection with the first two.

FRIDAY'S SESSION

The final session was held on Friday morning, when Professor A. H. Blanchard submitted a report as chairman of the committee on Standard Tests for Non-bituminous Materials, and another as chairman of the committee on Traffic and Transportation. The latter was followed by discussion by Leon Peck and others on the subject of jitneys and trackless trolleys.

Robert Ridgeway, chief engineer of construction of subways for New York City, then gave an excellent description of New York City's subways, illustrated by lantern slides, and discussed the conditions under which subways are practicable or advisable. Professor A. N. Johnson, of the University of Maryland, then discussed the subject of "The Engineer Student and Public Service." Moving pictures were shown by the Holt Mfg. Co. of snow removal from streets, and others of White trucks in use by street departments.

After adopting resolutions expressing hope for a successful outcome of the Conference on Limitation of Armaments, directing the sewerage committee to pay special attention to the utilization of sewage sludge on land during the coming year, and a resolution of thanks to the citizens of Baltimore and others who had contributed to the success of the convention, the convention adjourned. A considerable percentage of those present remained through the Friday session and many of them attended the luncheon at Druid Hill park and an automobile tour of Baltimore during Friday afternoon.

PUBLIC WORKS

Published Weekly
by
Public Works Journal Corporation

Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 30th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba. $3.00 year
All other countries .... $4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
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Unprecedented Public Work Forecast for 1922

The cities, counties and states of the country sold, during the ten months ending October 31st of this year, fifty per cent more bonds than during the same period of any previous year. The October sales—$108,076,143—have exceeded the sales made during the same month for the past decade by 70 per cent except in three instances. Moreover, there is still a strong demand for municipal bonds and the prices are good, and many more will undoubtedly be sold during the next few months.

Most of these bonds are for public work of some kind; and practically all of those sold after September of any year are for work planned for the following year. Consider also that there are probably more public funds than ever before held over from this year's appropriations in anticipation of lower prices and wages, and it is apparent that the outlook for public work in 1922 is far ahead of that for any previous year.

The exact figures on which the above statement is based have been compiled by the "Daily Bond Buyer" of New York, and are as follows:

Total sales of state and municipal bonds in October and in ten months ended October 31st, for the past ten years:

	October	Ten Months
1921	$108,076,143	$946,504,868
1920	62,592,014	627,494,610
1919	117,284,139	634,775,848
1918	10,292,635	217,275,175
1917	22,834,348	389,598,640
1916	56,943,946	433,285,461
1915	27,620,693	422,985,369
1914	11,332,910	381,955,569
1913	33,772,990	327,817,224
1912	23,310,025	354,988,886

The "Bond Buyer" considers that the total for this year will certainly exceed a billion dollars.

With a good market for bonds, most materials at prices that cannot at present fall much lower and may rise, and the need and general desire to furnish work for the unemployed, there is every reason to believe that 1922 will be a record year for public works construction.

Sewage Sludge Disposal

Sewage can be run into rivers or the ocean and so pass at least out of the ken of the city in which it originated, and the same is true of the effluent of sewage treatment plants. But all such plants retain a considerable part of the solids (in spite of the hopes of liquefaction by septic tanks that were entertained twenty years or so ago), and these solids cannot be so readily disposed of, and therefore furnish the most difficult problem connected with such plants.

These solids contain some materials that of themselves have a commercial value, but years of investigation have failed to reveal a method of realizing on this value. Probably no one of recent years has done more work in an effort to solve the problem than T. Chalkley Hatton, in connection with his Milwaukee experiments on activated sludge. In this issue of PUBLIC WORKS his belief is expressed that sludge will be generally used on land for its fertilizing value. Some think that this is hope born of his enthusiasm rather than of his experience; but there are indications that his anticipations may be realized some time, even though he and the writer may not live to see it. Encouragement for this belief is found in the fact, narrated last week, that in Rochester sewage sludge is being bought by farmers.

One promising development is the decrease in the number of horses as automobiles increase, with the consequent decrease in the amount of manure available. At the same time the land is continually losing more and more of its fertility and needs more and more fertilizer. Also, as cities become larger and transportation more expensive, intensive farming becomes more profitable and necessary. And intensive farming is largely a matter of fertilizing. It remains, however, to so treat the sewage and its sludge as to make the latter easily assimilable by vegetation and convenient for handling, and it is this last that Mr. Hatton deals with chiefly in his remarks.

Federal Aid Road Bill

As we go to press we are informed by Thos. H. MacDonald, chief of the Bureau of Public Roads, that the Federal Aid Road Bill has been passed by both house and senate, but not yet signed by the President; and that this appropriates $75,000,000, $25,000,000 immediately available and $50,000,000 on January 1 for post roads; also $15,000,000 for forest roads, $5,000,000 immediately available and $10,000,000 on the first of next July. This will enable many of the states to plan immediate work for unemployed, although presumably it will be some time before they can receive actual approval of their plans by the Bureau of Public Roads and be certain of receiving Federal aid therefor.

Ten Years of the St. Louis Water Works

Improvements made during the period of Edward E. Wall's service as Water Commissioner. Filter plants put into service, efficiency of boiler room greatly improved, capacity of supply increased. Some recent changes in the filtration plant.

The fiscal year 1920-1921 of the St. Louis Water Division was the tenth year of Edward E. Wall's connection with the division as water commissioner, and this fact was recognized by including with the annual report for this year a brief resume of the changes during this ten-year interval.

The first two years were occupied largely in investigating conditions and planning improvements, so that the actual developments that have taken place have been confined largely to the last eight years.

QUALITY AND QUANTITY OF WATER

Probably the most important feature is the improved quality of the water. In 1912 the water delivered to the mains was only partially purified and was not even perfectly clear a large part of the time and was sometimes decidedly turbid. Since 1915, when the filters went into operation, all the water pumped into the mains has been brilliantly clear and free from pathogenic germs at all times. The additional cost of improving the quality of the water by filtration was $3.68 per million gallons in the last fiscal year.

Next to quality, the most outstanding improvement has been in the quantity of water furnished. The average daily consumption in 1913 was 82,000,000 gallons, while for the past fiscal year it was 104,000,000 gallons, an increase of 27 per cent. The quantity of coal burned per million gallons of water pumped has meantime decreased from 4,250 pounds in 1912-13 to 3,000 pounds in 1920-21, or 23.53 per cent. This decrease in coal consumption shows the marked economy which has been effected at the pumping stations by the installation of improved machinery, by the introduction of better operating methods and a careful and continuous study of existing conditions.

IMPROVED EFFICIENCY

Another indication of improved efficiency in the department has been the reduction in the number of employees from 872 to 830, in spite of the fact that new duties have been placed upon the Water Division which called for 86 employees. That is, considering only the work that was being done by the Water Division in 1913, the same class of work is now being done with 128 fewer employees in spite of the 27 per cent increase in quantity of water supplied. These 86 additional employees include the 51 under the assessor of water rates, which were placed under the Water Division by the new charter of 1914; 23 employees were added by the installation of the filtration plant and 12 turnkeys were transferred to the Water Division from the collector's office in 1916.

The average salary paid at the earlier date was $63.77, while during the past fiscal year it was $140, and the total expenditure for salaries and wages increased from $667,333 to $1,402,109. In addition to the increase in salaries, the cost of materials has increased even more; lime from $4.04 a ton to $12.85, coal from $1.65 per ton to $3.88, sulphate of iron from $8 to $16.80, cast iron pipe from $24.75 to $75, and other materials in approximately the same proportion. The total net cost of operation and maintenance last year was $2,185,342.

Owing to advance in wages and prices and increased duties, a direct comparison with the cost eight years ago would have no special significance; but if the operations of last year were calculated on the basis of the same corporate efficiency, wage schedule and general prices prevailing eight years ago, a saving would be shown of $197,420. This sum expresses in dollars and cents the present annual value of eight years of careful study and close observation of the conditions affecting the administration of water works business, combined with the judicious installation of appropriate modern appliances and machinery and a decided tendency to adopt new methods and to pursue new policies whenever they promise to be better than the old.

BOILER ROOM IMPROVEMENTS

One of the improvements made by Commissioner Wall has been the substitution of mechanical firing for hand firing, and the completion of the reconstruction of the boiler plant at the Baden pumping station last year marked the final abandonment of hand-fired furnaces at all the high-pressure steam plants of the division.

The use of these stokers has materially reduced the cost of steam production at all of the plants. Taking High Service Station No. 3, the coal consumption dropped from 3,500 pounds per million gallons pumped in 1913 to 3,050 in 1915, owing to special efforts which were made to improve the method of firing in conjunction with CO_2 studies. A convenient arrangement of damper regulation was installed which encouraged the firemen to use the dampers, boiler settings were gone over, cracks stopped up, broken baffle tiling renewed, and the air spaces in the boiler settings were filled with cinders. In 1917-18 occurred a further drop to 2,625 pounds, due to close and intelligent attention to operating conditions in the boiler and engine rooms.

High Service Stations Nos. 1 and 2 showed a drop from 2,540 pounds in 1913 to 1,825 pounds in 1921, and Low Service No. 2 showed a drop from 1,175 pounds in 1916 to about 800 pounds in 1921. The reduction in Stations Nos. 1 and 2 is attributed to improvement in equipment, including installation of feed-water heaters and new boilers with superheaters.

FINANCES

In spite of the great increase in consumption and increase in expenditures, the net income for the past year or two has shown comparatively little increase. It is expected, however, that a considerable improvement will be shown this year, due to the elimination of the 10 per cent discount for cash which had previously been granted. The supervisor of the assessment section comments on this as follows: "The elimination of discount hurts no one in particular as it covers all consumers and it has always been a source of a great many complaints and a question as to the right of the city to allow discount on water bills and not on other bills. It would appear to be better policy to add a penalty for failure to make prompt payments, the same as on tax bills. The argument against eliminating the discount, that it would tend to hold back payments and cause a large increase in uncollected bills, has proven entirely unfounded."

The general rates are much the same as in 1913, both the meter rates and the flat rates, both of them showing slight decreases for moderate quantities of water and slight increases for the largest users. Of the total income last year about 40 per cent was from meter rates and 56 per cent from flat rates, with the balance from miscellaneous sources.

Up to the present the Water Division has paid from income not only operating expenses, but also its extensions, maintaining a reserve fund for the latter purpose. This reserve, however, is now reduced to the point where it is by no means sufficient for extensions that are immediately imperative and Commissioner Wall makes a plea for more justice in the dealings accorded the division by the city. A power plant at the sanatarium is used for pumping water to the additional height necessary to supply these buildings, the same plant being used for other purposes which require considerably more of the power than does the pumping. In spite of this, the Water Division is charged with the entire operation of these plants, amounting to about $150,000 a year. There are a number of other charges placed against the division on the city's books which show that, as in many other cities, St. Louis has been using the water rates to help it lower the tax bills.

Of the program laid out eight years ago and which has been modified from time to time as developments in the water works art or increased information has dictated, the only principal features which have not been carried out have been the addition of two 20,000,000-gallon pumps and a 36-inch pump main, a new clear water basin and the covering of two basins to prevent pollution. These would probably have been completed had it not been for retrenchments made necessary by the war.

As it is, the present equipment will probably be insufficient to furnish the quantity of water needed by the city within the next five years. Even if metering be increased from its present 32½ per cent of consumption to universal metering, it probably would not permit postponing construction of new works, although it might permit putting off a portion of the final expenditures for a considerably longer period. Entirely aside from these necessary enlargements, however, Commissioner Wall reports that: "Unless something is done this year towards providing greater revenue, or in some other way means are found to increase the sum annually available for additions and improvements, it will be but a short time thereafter until the situation becomes so acute that the occasional temporary shortage of water in the higher levels of the city grows into more than an inconvenience and begins to cause distress and endanger lives and property."

THE WATER WORKS RAILWAY

One source of loss is the water works electric railway. This was built at first for the construction of the Chain of Rocks filter plant and later for transporting chemicals and other materials to the plant. It was decided to increase its use by carrying passengers to the Chain of Rocks plant, the land around which had been developed as a park. The fare charged for this is eight tickets for 25 cents, which fare has been maintained in spite of the great increase in the wages of the car crews. Because of this increase, the revenue from the passenger service last year was $4,303 less than the wages paid the motormen and conductors. During the past year 479,292 passengers paying fares were carried by this railway, the maximum traffic being on July 20, when 6,557 passengers were carried to Chain of Rocks. C. M. Daily, the engineer in charge of the Chain of Rocks plant, estimated that nearly 8,000 would probably use the railway on the heaviest traffic days of the following season. He therefore recommended that the fare be increased to 5 cents or six tickets for 25 cents for adults and 3 cents or 12 for 25 cents for children. During holidays and whenever necessary a 15-minute schedule is maintained if possible. The roadbed of this railway is now being gradually widened so as to provide for double tracking it at some future time.

FILTRATION PLANT

During the thirty years prior to 1895, when the new intake at Chain of Rocks went into service, the typhoid rate had varied from a maximum of 110 to a minimum of 21. For a few years the rate remained at about 21 until the opening of the Chicago drainage canal, when it rose by almost uniform increments to a maximum of about 48 in 1904. In 1904 clarification of water began and the rate dropped immediately and noticeably, at no time after that date exceeding 20 and averaging about 15. With the beginning of filtration in 1915 the rate dropped still lower, the maximum since that date having been below 10 and the rate averaging about 7, reaching its lowest point in 1920 when it was 2.7 per 100,000.

The filtration plant has already been described in this journal, but a brief synopsis of the description may be of advantage here.

The plant, which was completed in November, 1915, has cost $4,550,000. It has a rated capacity of 160,000,000 gallons daily and includes an 800,000,000-gallon grit chamber, mixing conduits and mixing chamber, settling basins with combined capacity of 220,660,000 gallons, and secondary sedimentation basins. Also filtered-water basins and reservoir with a total combined capacity of 165,000,000. There are 40 filter units with a net area of 60,000 square feet, containing 12 inches of graded gravel and 30 inches of sand, the latter with effective sizes varying from 0.31 mm. to 0.46 mm.

The chemicals used are lime, sulphate of iron, sulphate of alumina and liquid chlorine. The lime is applied at the entrance of the mixing conduits after the water has passed through the grit chamber; sulphate of iron at the exit from the mixing conduits; sulphate of alumina in the conduit between the primary sedimentation basins and the secondary mixing chamber, in the influent flume leading to the filters, and after washing, and also in the central gutter of each filter to the incoming water for a few minutes; and liquid chlorine is added to the filter effluent.

Several months ago we described the cleaning of the filter beds and removing of mud balls from them by jetting the sand from one side to the other without removing the material from the beds. This method was employed again last year, more, however, to remove the soft coating that was accumulating on the sand before it had had time to harden, than to remove mud balls. The coating on the sand grains is increasing at an accelerated rate, even with the periodical scrubbing by jets, and it is probable that within a few years it will be necessary to replace the sand in all of the filters. Two years after placing the sand, it was found that the percentage of coating on the sand amounted to 2.9 per cent, in 1919 it had increased to 5.4 per cent, and this year it was found to have increased to 15.0 per cent.

The cause of the accelerated rate by which the sand grains accumulate this coating is probably the influence which the coating itself exerts on the dissolved matter carried in the water, this probably being in proportion to the volume of the coating. Clay, ferric-hydroxide and aluminum hydroxide form about 43 per cent of the coating and calcium carbonate and magnesium hydroxide 56 per cent. The reduction in alkalinity of the water in passing through the sand has been about three parts per million and has not varied much from that figure during the past four years.

MUNICIPAL MANUFACTURE OF LIME

Because of the great increase in the cost of lime—$12.55 per ton as against $3.40 four years ago—which increase in price represents $144,528 per year, the Water Division is considering the manufacturing of its own lime. It has estimated that the cost of manufacturing a ton of lime at the filter plant in a modern rotary kiln using powdered coal for fuel would be as follows:

2 tons of limestone at $2.50	$5.00
¼ ton powdered coat at $5.00	1.25
1 hour of labor at 52c	.52
15 kw. of power at 2 2-3 cts.	.40
Repairs and supplies	.40
Miscellaneous expenses	.13
Total cost	$7.70

The estimated cost of a rotary kiln of 110 tons per day capacity, which is 50 per cent more than the maximum daily consumption of the St. Louis plant, is $110,000, while the necessary accessories would add $20,000. Charging 6 per cent annual interest on the $130,000, and a sinking fund based on 4½ per cent and 10 years life would add $1.15 per ton to the cost on the basis of 16,000 tons per year manufactured, giving a total estimate of $8.85 a ton for manufacturing lime, or $3.70 less than the present basic price. It is estimated that an additional saving of $.40 a ton could be made by the use by the steam boilers of the heated gases from the kilns.

During the year 122,194 pounds of chlorine were added to the filtered water, the maximum charge being 7 pounds per million gallons and the average 3.1 pounds. During the same period 2,264 tons of aluminum sulphate were added to the settled water, the charge varying from 1.75 grains per gallon to a minimum of 0.25, the average being 0.8043 grain per gallon of water filtered.

The alum had formerly been stirred in the solution tank by an agitator and vertical motor, but last year this was replaced by an air lift agitator. Air lift agitation has been so successful and the maintenance so much less expensive, that the remainder of the motor driven agitators will be replaced in the near future.

How to Finance A Job

Cash provided by the contractor, the owner or by corporation financing. Amount and terms of payments and disbursements vary with character of work. Necessity for experienced estimates of indirect costs and obligations.

The essential features and methods of providing money for the execution of a construction contract vary with the nature and magnitude of the work. For very simple, ordinary work, not subject to change or interruption during construction or to changed conditions or requirements, and for construction that consists chiefly in the assembling of commercial materials and installation of standard manufactured equipment, the contract itself affords good security and little difficulty should be experienced by a reliable contractor in securing the funds necessary to supplement his own capital. For very uncertain, dangerous or changeable work or for long continued work, involving large outlays at the beginning, much more difficulty is experienced.

SIZE AND CHARACTER OF WORK

For ordinary construction work of a standard character under reasonably favorable conditions, the contractor should have resources, that is, cash or credit, plant and organization sufficient to carry the work to completion without assistance for jobs up to, say, $100,000.

For the same class of work on jobs up to, say, $1,000,000 the contractor's resources, supplemented by progressive payments made from the engineer's estimates, should suffice to carry the job without calling in outside help or paying for borrowed money.

For much larger work the contractor may be competent to direct the execution and to create and handle the organization, select and install equipment and devise the necessary methods, without having sufficient financial reservations, or facilities to secure the necessary capital or to secure it on advantageous terms. If, however, he has a moderate amount of available cash, resources and plant, and has a good reputation for integrity, successful work and satisfactory methods, he should be able to secure the necessary financing on fair terms, enabling him to pay a reasonable amount for the extra credit and the use of outside money and still gain a comparatively high return on the equity of his actual investment on the principle of repeated turnovers, because it is almost always possible to carry out a large successful contract without the actual investment at any one time of more than a fraction of the total value of the contract.

PRINCIPAL OUTLAY

For a small job the regular employees and plant may suffice; materials should be paid for on delivery, thus securing all possible discounts, and the work should not be commenced until it is possible to push it through at top speed, complete without interruption, and secure final payments not later than the time of acceptance of the job.

For larger jobs the contractor must plan to supplement his plant and equipment by construction or rental or by purchase on terms that will enable him to make part payments from the proceeds of the job; he must have sufficient cash balance to provide liberally for traveling expenses, field office, and emergencies of various kinds and to be certain of abundant funds for payment of the payroll until after sufficient payments become due under the terms of the contract to meet them and any other obligations maturing from time to time, sufficient margin must also be allowed in every case for any probable refusal of payment or delay in making it.

REASONABLE CREDITS

If there is a large amount of manufactured equipment to be installed or commercial materials to be used, the contractor should study the situation when he makes his estimates and probably arrange to make his final payments subsequent to the date when he will receive his corresponding payments from the owner, thus carrying only a portion of the total cost to which, of course, must be added abundant provision for freight, transportation handling, installation and other incidentals, and ordinary supplies. With careful estimates and conservative operations the contractor will thus be able to make his capital and receipts keep a good balance ahead of his disbursements, and arrive at the completion of his contract with a comfortable cash surplus besides the entire retained percentage that should be only a portion of the net profit.

SPECIAL NECESSITIES OF BIG JOBS

Large construction contracts, running into several millions of dollars usually extend over several years and involve large preliminary outlays, which, if the work is very uncertain or dangerous, are likely to require resources beyond the limit of the individual or corporation, so that financial help will be required, especially for certain kinds of difficult work in which the principal factors are labor and costly equipment as, for instance, in tunneling or heavy excavation and grading that demand heavy initial outlay and large payrolls from the outset.

The construction, for instance, of a $10,000,000 or a $20,000,000 dam or reservoir with its appurtenances may call for an initial outlay of 10 per cent or more for plant and equipment. This proportion is frequently attained and even exceeded, so that such a high percentage has sometimes been considered as a kind of insurance and an indication of good judgment in expediting and safeguarding the work with abundance of high-class equipment that tends toward rapid and economical results. Sometimes indeed the best preliminary investment has to be much more, as, for instance, when the work in a remote and mountainous country involves the construction in advance of a service track miles long through difficult country to secure connection with an existing railroad. The building of camps which sometimes require to be provided with costly water supply and sewage disposal, and always need, for a large number of men, commissary and hospital equipment and other outlays that are likely to be large.

Considerable money is frequently spent in locating, opening and equipping quarries, sand pits and perhaps sawmills or on some occasions in the construction of a dam and the installation of a temporary hydro-electric to provide power for construction operations that may result in great economy and rapidity of work, but which involves the expenditure of much time, labor and money before any returns can be received under the contract proper.

Of late years construction work is especially vulnerable to violent labor troubles and unlooked-for increase of costs as well as to political upheavals and great changes in the material market, unforeseen delays in transportation and shutdowns, disorganization, extra costs and sometimes destruction of property through strikes and other factors, all of which are more likely to increase cost and delay payment than to operate to the contractor's advantage.

It is assumed that the contractor is experienced in the class of work undertaken, has a well-established reputation for integrity and the successful completion of his job, is in good standing with the surety bonding company, has a reasonable amount of valuable plant and equipment and the nucleus at least of a complete construction organization with competent assistants, foremen and superintendents, and a reasonably large amount of cash to insure a fair portion of equity in the work.

With these qualifications and a desirable contract affording a probable profit of from 10 to 20 per cent, according to the character and conditions of the work, the contract itself becomes a valuable collateral and the contractor should be able to establish relations with two or three banks from which he can borrow from $50,000 to $100,000 every month or two on 90-day 6 per cent notes, with the understanding that as they mature they can be renewed for three months on a payment of 20 per cent, and so on, thus providing additional cash for preliminary and current expenses until the latter can be met and exceeded by partial payments earned on the contract.

Usually only a portion of the plant ultimately required has to be installed at the outset, and this is generally of a standard nat· · likely to be included in the contractor's regular equipment. Additional standard plant can be generally purchased for part cash and part credit up to 90 days, which practically has to be paid for out of the original resources. Special equipment required as the work progresses may perhaps be paid for by the proceeds of the work as it is advanced.

Important material supplies can be contracted for generally at the beginning of the work so as to insure against a rising market and under an agreement for delivery as required on giving due notice. On these again some credit may be obtained after delivery and it is often possible to arrange the contract so as to receive the engineer's estimate and payment successively for the shipment, delivery and installation of the materials, thus keeping so close to the contractor's disbursements that he only has to carry a reasonable part of the total cost.

Very ample provision must be made for fixed and overhead charges, which must include renewals, depreciation, amortization (both of these sometimes amounting to 100 per cent), interest, cost of surety bonds, insurance, engineering, freight and transportation, auxiliary work, taxes, permits and sometimes political outlay, maintenance of general and field offices, proportions of general yearly business expense, contractor's salary, and liberal allowance for contingencies, accidents and emergencies, as well as for delayed or contested payments and the inevitable reserved percentage with possibly disputed claims for extra work and classifications and legal expenses.

The complete overhead may thus run from 10 to 50 per cent of the total cost of the work and great care should be taken to distribute it, in a unit price contract, among quantities that cannot be diminished and as far as possible on those that receive large and steady payments only in construction operations.

As labor insurance is costly it may on very large work, where great numbers of men are employed, be much more advantageous for the contractor to insure himself by establishing a fund of a certain percentage of the payroll, shown by experience to be adequate for accident liabilities, and to maintain it ready for claims, penalties and compensations.

Abundant allowance must be made for the transportation, installation and removal of heavy plant, for the supply of coal in remote localities and for the maintenance and repairs of certain items of equipment that are subject to rapid depreciation, such, especially, as locomotives, dump cars, steam shovels, and wooden derricks that are quite likely to depreciate 50 per cent in four or five years and under severe conditions or careless management may easily need complete renewal before the end of the job. On large work economy demands and will justify the establishment of well equipped machine and repair shops and their maintenance with spare parts and supplies at a cost of from $50,000 to $100,000 per year.

A great danger to inexperienced contractors, and one that is responsible for a large proportion of failure is a lack of appreciation of the danger from delays, interruptions and unforeseen changes and the fact that liabilities are likely to be much more urgent than assets, so that a troublesome creditor may ruin a business that cannot quickly enough realize on abundance of good but slow assets or on payments withheld by powerful municipalities or corporations.

A young contractor is too likely to feel that a price 20 per cent larger than a careful estimate of direct cost of labor, material and plant insures an adequate profit, and then loose heavily through unforeseen delays, rising costs, accidents, arbitrary change of quantities or classification, failure of subcontractor or dealers, conflict with municipal regulations, etc., and he is very likely to under estimate overhead charges and the general cost of doing business and attempt to work on too narrow margin.

Recent Legal Decisions

STREET SPRINKLING ASSESSMENT—BENEFITS NEED NOT BE EQUAL IN ALL CASES

The Louisiana Supreme Court holds, City of Lafayette v. Tanner, 89 So. 314, that article 225 of the state Constitution, providing that taxation shall be equal and uniform throughout the territorial limits of the authority levying the tax, and that all property shall be taxed in proportion to its value, is inapplicable to local assessments imposed upon the theory of special benefits to the locality in which they are levied. Where the cost of sprinkling streets in an assessment district exceeded by $22.49 the revenue from the assessment of land within the district for such purpose, the assessment was held not excessive or out of proportion to the actual cost. It was also held that where a street bounding a sprinkling district duly created by ordinance was not sprinkled, the assessment of land bounded in the rear by such street at the same rate as land not on the edge of the district did not constitute the taking of private property without due compensation and without due process of law. It is not essential to the validity of a local assessment or forced contribution for street improvement that all persons on whom the assessment is levied shall be equally benefited. It is sufficient if the apportionment of the assessment has a reasonable foundation of fairness and equality, and is not arbitrary or discriminating.

CITY REMEDYING DEFECT IN STREET LIGHTING WITHIN 30 OR 40 MINUTES AFTER NOTIFICATION NOT NEGLIGENT

The Maryland Court of Appeals holds, in an action against a city for damage to an automobile from collision with an unlighted concrete wall separating a driveway and footwalk, Charles v. Mayor, etc., of City of Baltimore, 114 Atl. 565, where there was evidence that on the night of the accident the electric lights had gone out because of short circuiting caused by intensely cold weather, and that only 30 or 40 minutes elapsed after the city received notification of this condition, during which interval the accident occurred, the city was not guilty of any negligence rendering it liable.

COMMISSIONS AS ADVISORS TO MUNICIPALLY OWNED PLANTS

The Michigan statute of 1919 provides that it shall be the duty of the Public Utilities Commission "on the request of any city or village to give advice and render such assistance as may be reasonable and expedient with respect to the operation of any utility owned and operated by such city or village." Under the statute the commission has no control over rates, service, or operation of such municipally owned utilities, and no power to compel the municipality to accept its advice. Discussing an application for advice and assistance by the village of Manchester regarding the operation of a municipal electric light plant, the commission holds that it is not authorized to act as a consulting engineer in the preparation of plans, specifications, blueprints or working details for buildings or machinery for any municipal utility, or make surveys, estimates, etc., of its physical property, or act in an advisory capacity except in relation to the operation of plants already built or in operation.

LIABILITY OF MUNICIPALITIES IN OKLAHOMA FOR POLLUTION OF STREAMS BY SEWAGE—LIMITATION OF DAMAGES RECOVERABLE BY PROPERTY OWNER

In City of Cushing v. Luke, Oklahoma Supreme Court, 199 Pac. 579, the court said: "The case at bar is similar to several other cases decided by this court, holding that where a municipal corporation discharges sewage into a river or creek, polluting the water of the stream, causing it to become foul and impregnated with noxious and poisonous substances, rendering it unfit for domestic or other uses, and thereby creating and maintaining a nuisance which is detrimental to the health, comfort and repose of a lower riparian owner, and diminishes the value of his land, such municipal corporation is liable for damages arising from the maintenance of such nuisance."

Following are a few of the cases to this effect: Markwardt v. City of Guthrie, 18 Okla. 32; Colbert v. City of Ardmore, 31 Okla. 537; City of Chickasha v. Looney, 36 Okla. 155; City of Cushing v. High, 175 Pac. 229. In the latter case the court held: "In this jurisdiction it is well settled that, where the injury complained of is susceptible of remedy or abatement by the expenditure of money or labor, the owner is entitled to recover only such damage as has accrued on account of the impaired or lost use of his property up to the time of the suit."

NO DUTY ON VILLAGE TO RESTRAIN CONSTRUCTION OF SIDEWALK IN VIOLATION OF ORDINANCE

In an action by resident property owners to enjoin a village from allowing a certain sidewalk to be constructed contrary to an established grade and in violation of an ordinance of the village governing the construction of sidewalks, where there was no evidence to show that the village had either authorized the construction of such sidewalk or that it had taken any part in such construction, the Nebraska Supreme Court holds, Shanner Bros. v. Village of Page, 184 N. W. 131, that the district court's action in discussing the cause at the close of the plaintiff's evidence was proper. The court said that "there is no duty resting upon the village to maintain an injunction suit against the parties responsible for the improvement, for the protection of aggrieved citizens or complaining parties. If sidewalks are being constructed by private parties in violation of the ordinances of said village, these plaintiffs, if they have a right of action at all, can maintain it themselves against the responsible parties, and are in no position to maintain an injunction suit against the village to restrain it from 'further permitting' the work to be done."

NEWS OF THE SOCIETIES

Nov. 13-17—AMERICAN CIVIC ASSOCIATION. Chicago, Ill. Headquarters, 905-7 Union Trust bldg., Washington, D. C.

Nov. 14—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with A. I. E. E., A. I. M. E. and A. S. C. E.

Nov. 14—NEW HAVEN BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Mason Laboratory, Yale University. Secretary, Prof. S. W. Dudley, 400 Temple st., New Haven.

Nov. 14 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies bldg., New York City. Sec., G. I. Rhodes, 115 Broadway, New York City.

Nov. 14-16—CITY MANAGERS' ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

Nov. 15—LEVEE AND DRAINAGE CONTRACTORS' ASSOCIATION. St. Louis, Mo.

Nov. 15—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Meeting. Automobile Club of America, New York City.

Nov. 15-16—OHIO VALLEY IMPROVEMENT ASSOCIATION. Evansville, Ind.

Nov. 15-18—ATLANTIC DEEP WATERWAYS ASSOCIATION. Savannah, Ga. Headquarters, Real Estate Trust bldg., Philadelphia, Pa.

Nov. 16-18 — NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

Nov. 16 — ST. LOUIS SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club. Secretary, Victor J. Azbe, Railway Exchange bldg.

Nov. 17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Society of Naval Architects and Marine Engineers. New York.

Nov. 17-18—SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS. New York.

Nov. 17 — BRIDGEPORT BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce.

Nov. 17—TOLEDO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Toledo Commerce Club. Secretary, Loring Freed, Atlas Chemical Co.

Nov. 17 — WORCESTER SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Worcester section, A. I. E. E. Secretary, Harry M. Latham, Crompton & Knowles Loom Works.

Nov. 21—CHICAGO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Western Engineering Society.

Nov. 22 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Nov. 22—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Adelphia Hotel.

Nov. 25 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel, Denver. Secretary, William Lester, Vulcan Iron Works.

Nov. 28-29—KANSAS CITY SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Two-day regional meeting. Secretary, Louis Bendit, 517 Finance bldg.

Dec. 1-3—MONTANA IRRIGATION AND DRAINAGE INSTITUTE. Great Falls, Mont.

Dec. 5-9—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual convention. New York City.

Dec. 6-9—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 14th annual meeting. Baltimore, Md.

Dec. 13—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary, N. L. Nussbaumer, 80 W. Genesee street, Buffalo.

Dec. 14—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' building, New York City.

Dec. 22-23—KANSAS ENGINEERING SOCIETY. Annual meeting. Hutchinson, Kan. Secretary, J. M. Averill, Topeka, Kan.

Dec., 22-23—KANSAS ENGINEERING SOCIETY. Hutchinson, Kan.

Jan. 4-14 — CLEVELAND, OHIO, BUILDING EXPOSITION. Municipal auditorium, Cleveland, Ohio.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING. 8th annual conference. University of Michigan, Ann Arbor, Mich.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.,; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

AMERICAN ROAD BUILDERS' ASSOCIATION

The annual meeting of the American Road Builders' Association will be held at the Automobile Club of America, New York, N Y., on Nov. 15. In the afternoon the officers of the association will render their reports and in the evening the incoming president and other officers for the ensuing year will be installed, followed by speeches by prominent members of the association.

One of the important matters to be considered at the annual meeting is the coming convention and good roads show of the association to be held at the Coliseum Chicago, Ill., on January 16-20, 1922. At last year's good roads show there were over 140 exhibits and from present indications this number will be greatly increased at the coming show. The amount of money now being expended on highway construction is now greater than that being spent on all other public works combined. The value of road machinery now being manufactured exceeds the total value of all other construction machinery being produced. More than one billion dollars is available in the United States for road construction.

In view of these facts, it follows that the coming convention and good roads show of the American Road Builders' Association will be the event of the year for highway officials, engineers and contractors, automotive engineers and manufacturers, and persons interested in highway transportation and highway finance.

ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS

At the meeting of the Associated Engineering Societies of St. Louis, held at the Engineers' Club, November 2, an address was delivered on "Meeting the Transportation Needs of a Metropolitan Public Under a Receivership and Looking Ahead," by Col. A. T. Perkins, manager for the Receiver of the United Railways Co. of St. Louis.

DETROIT ENGINEERING SOCIETY

The Detroit Engineering Society met at the Detroit Board of Commerce on November 4th. The feature of the meeting was an address on "Flood Control Work in the Miami Valley," by Charles H. Paul, chief engineer of the Miami Conservancy District, Dayton.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

A joint session of this society with the Society of Naval Architects and Marine Engineers will be held on November 17th at the Engineering Societies Bldg., New York City. The subject of the meeting will be "Electric Auxiliaries and Electric Propulsion of Ships" and papers will be presented by E. D. Dickinson, Marine Dept., General Electric Co., on "Electric Auxiliaries on Merchant ships," and by W. E. Thau, commercial engineer, Westinghouse Electric and Mfg. Co., on "Electric Propulsion." There will also be an address by Alfred N. Goldsmith, professor of electrical engineering, College of the City of New York, on "World Communication.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The annual meeting of the A. S. M. E. will be held in New York City, December 5-9. There will be Education and Training, Aeronutics, Fuel, Gas Power, Machine Shop, Management Materials Handling, Power, Railroad, Textile and General Sessions. The Keynote Session will be based on the report of the Committee on Elimination of Waste in Industry of the American Engineering Council.

PERSONALS

Kline, Virgil, has been appointed resident engineer for the Georgia state highways.

Thompson, John, has been appointed clerk of the Lynn, Mass., water department.

Fitzgerald, David E., who is closing his second term as mayor of New Haven., was re-elected for a third two-year term.

Guilfoyle, Francis P., was elected mayor of Waterbury, Conn., and Miss Dora Eagan was elected town clerk.

Calder, J. W., city engineer of Swift Current, Sask., has been dismissed by city council, as was the chief of police.

Negstad, Henry, has been appointed county highway superintendent of Brookings county, Brookings, S. D.

Gresham, Joe, county engineer of Coldwell county, Texas, has been appointed county engineer of Travis county, Texas.

Clements, Grover E., of Mount Gilead, Ohio, has been appointed chief engineer of the State Department of Highways and Public Works of Ohio.

McClelland, George A., formerly district engineer of the Texas Highway Commission, has been appointed county engineer of Harrison county, Texas.

McConnell, Howard F., mayor of Montclair, N. J., has been appointed a member of the State Board of Conservation and Development, to succeed William E. Tuttle, Jr., who resigned.

Raub, Edward B., was chosen president of the city planning commission of Indianapolis; Emerson W. Chaille was elected vice-president, and Louis W. Bruck secretary.

Mills, Hiram Francis, well-known hydraulic engineer, died on October 4th at his home in Hingham, Mass., after a long illness.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

BUCYRUS CLASS 72 TRENCH EXCAVATOR

The Bucyrus Class-72 trench excavator, described in bulletin T-1002, of the Bucyrus Co., has been designed with the great strength, simplicity and ruggedness of a steam shovel, so as to execute the most difficult work with the greatest rapidity and a minimum cost of maintenance. The machine is about 15 feet high, 10½ feet wide, and 33 feet long, exclusive of the ladder and weighs 77,000 pounds. It is mounted on caterpillar traction with 8 x 12-inch double engines and an independent double conveyor engine has a road speed of ¾ mile per hour and can dig trenches of 72, 60, 48, 36, or 24-inch width, to a depth of 20 feet at a speed of 20 to 275 linear feet per hour.

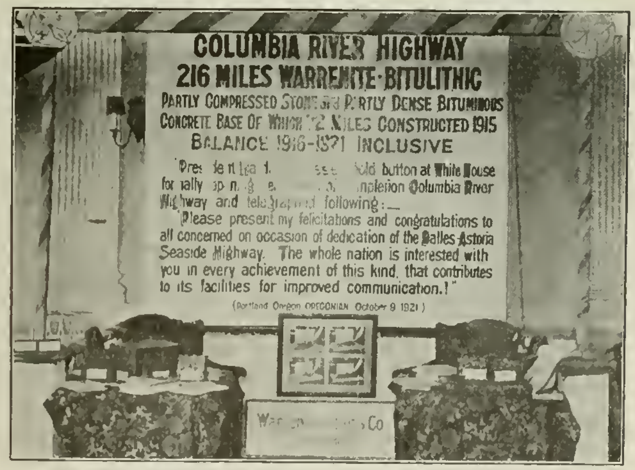
The gears, bearings, shafts, engines, boiler, etc., are of steam shovel design, making it extra strong to insure maximum service and prevent breakdowns. The open scraper-type buckets are made of triple annealed special alloy steel and can be easily attached and detached from the chain links. Sprockets, chains and belts have been entirely eliminated in the main drive that is operated from the engine pinion through two steel crank discs.

The standard ladder can be adjusted to a minimum depth of 12 feet or extended to a digging limit of about 20 feet. The variable conveyors deposit spoil in any position up to 20 feet away from the machine. The digging speed is changed without stopping the machine and all of the control levers are within easy reach of the operator who has full view of the machinery, conveyor and the bottom of the trench, as well of the road ahead.

One of these machines was used for the heaviest excavation required on a $750,000 contract for laying 36 miles of sewer pipe at a maximum depth of 22 feet in the city of Wichita Falls, Texas. The material was mostly red clay and quicksand and the cost of excavating 19,581 cubic yards was $3,719.90. The machine excavated a trench 5 feet wide and 21 feet deep at the rate of 1 linear foot per minute.

ROAD BUILDING EXHIBIT

Among the exhibits at the annual convention of the American Society of Municipal Improvements, held in Baltimore, October 25-28 was an attractive display presented by Warren Bros. Co., Boston, showing sections and samples of the Warrenite pavement, which they have constructed in all parts of the country giving prominence to the work on the great Pacific Coast scenic highways. In their booth was displayed a conspicuous announcement "Columbia River Highway 260 miles Warrenite Bithulithic, Partly Compressed Stone and Partly Dense Bituminous Concrete Base of which 72 miles Constructed in 1915, Balance 1916-1921 inclusive. President Harding Pressed Gold Button at White House, formally opening celebration of completion of Columbia River Highway and telegraph following: 'Please present my felicitations and congratulations to all concerned on occasion of dedication of the Dallas-Astoria Seaside Highway. The whole nation is interested with you in every achievement of this kind, which contributes its facilities for improved communications.' " Portland, Ore., Oct. 9.


COLUMBIA RIVER HIGHWAY
216 MILES WARRENITE-BITULITHIC
PARTLY COMPRESSED STONE AND PARTLY DENSE BITUMINOUS
CONCRETE BASE OF WHICH 72 MILES CONSTRUCTED 1915
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(Portland Oregon OREGONIAN October 9 1921)
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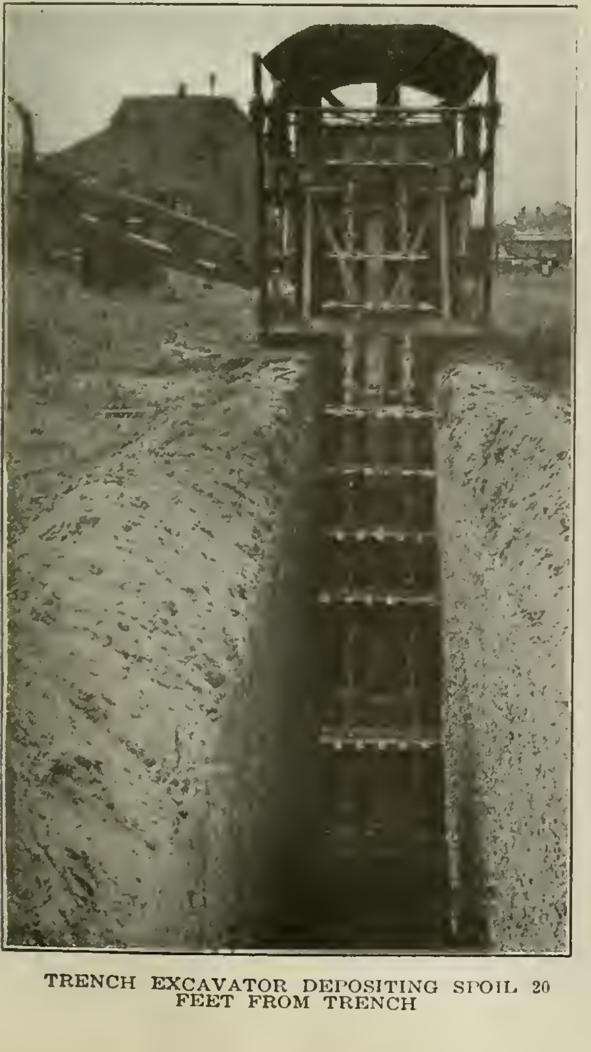
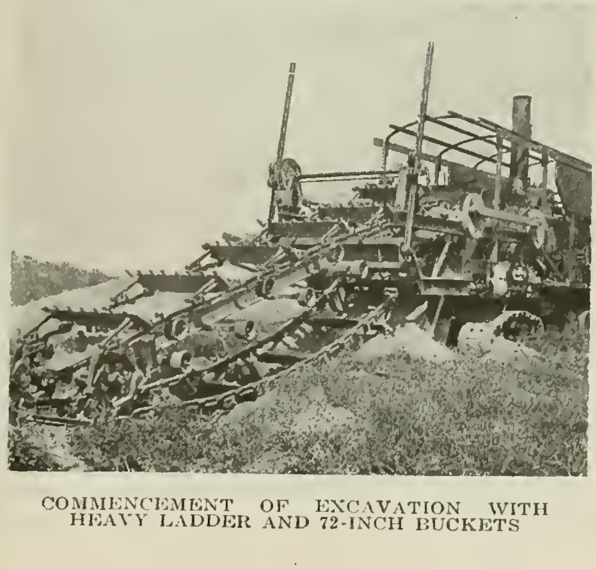


TRENCH EXCAVATOR DEPOSITING SPOIL 20 FEET FROM TRENCH



COMMENCEMENT OF EXCAVATION WITH HEAVY LADDER AND 72-INCH BUCKETS

New Catalogs of Interest to City and County Engineers, Superintendents of Water Works, Superintendents of Streets, Contractors and All Engaged in Public Works

If you want any of these Catalogs, write the number on a postal, sign your name and address plainly, and mail it to PUBLIC WORKS, 243 W. 39th St., New York. The Catalogs will be sent to you promptly without charge or obligation.

ST. MARYS SUPER-DIESEL HEAVY DUTY OIL ENGINES

209. St. Marys Oil Engine Co. St. Charles, Mo. Bulletin No. 55, describing engines of 20 to 60 h. p. that use crude oil at a great economy over gasoline engines and eliminate ignition systems, carburetor, fuel pump and torch. A 4-cycle type with intake, exhaust and fuel valve operated mechanically.

ST. MARYS SUPER-DIESEL 4-CYCLE OIL ENGINE

210. St. Marys Oil Engine Co., St. Charles, Mo. Bulletin 54, describes 4½ h. p. engine without ignition system or carburetoring devices that will start and operate on kerosene, solar oils, fuel oil or any cheap distillate liquid at an estimated saving of $512 per year over gasoline burning engines of the same power.

POWER DRAG SCRAPERS

211. L. P. Green Lumber Exchange Bldg., Chicago, Ill. Leaflet describing bottomless type steel plate scraper, can be used under water and for excavating and conveying material, and is built in sizes of ½-yard to 5-yard.

MACHINERY AND CASTINGS

212. Duncan Mackenzie's Sons Co., Trenton, N. J. 6½ x 10 inch, 64-page, catalog, foundry and general machinery work for gray iron, acid and heat resisting castings and special machinery for clay working, pottery, electric porcelain, tile making and all kinds of mill machinery.

STEAM AND POWER PUMPING MACHINERY

213. Union Steam Pump Co., Battle Creek, Mich. Adjustable folder, containing many 6 x 9-inch bulletins from No. 18 to No. 70, illustrating and describing the large number of plunger pumps, centrifugal pumps, belt driven pumps, compound pumps, duplex pumps, vacuum pumps, hydraulic pumps, boiler feed pumps, turbine pumps and many special kinds of pumps, also air compressors, receivers and condensors.

CAPSTANS

214. S. Flory Mfg. Co., Bangor, Pa. Catalog 33, 6 x 8½ inches, describing hand, steam and electric winches and gypsies.

CONE FRICTION HOISTS

215. S. Flory Mfg. Co., Bangor, Pa. Leaflet illustrating Cone Friction Drums and electric hoists, designed for severe service. In sizes of 7½ to 75 h. p.

COLUMBIA TRUCKS

216. Columbia Motor Truck & Trailer Co., Pontiac, Mich. Bulletin, describing new 2½-ton Columbia trucks.

MAN POWER MULTIPLIED

217. The Brown Hoisting Machinery Co., Cleveland, Ohio, booklet 2-21, 6½ x 11 inches, 12 pages, illustrated, diagrams and details and data of Brown Hoist No. 2 locomotive crane showing its operation equipped with plain or magnetic hoists, clamshell or dragline buckets and mounted on stationary pedestals, trucks or creeper traction, performing many different kinds of work.

NOVO RELIABLE POWER

218. Novo Engine Co., Lansing, Mich., catalog 921, 6 x 9 inches, 105 pages, illustrated, stiff covers. Gives details and specifications of Novo gas, gasoline and kerosene engines and air compressor, pumping, hoisting and sawing outfits. This catalog has been revised and in addition to equipment shown in former catalogs gives new designs of pumps and hoists of larger capacity and illustrates a saw rig and an 80-foot compressor outfit, the latter assembled with fans and radiator and a forced circulation water cooling system.

AIR AND GAS COMPRESSORS

219. Nordberg Mfg. Co., Milwaukee, catalog, 10x8¼ inches, 120 pages, illustrated, heavy paper, stiff embossed covers. Contains much information about design, operation and efficiency; describes new features and radical departures from old practise with special attention to economic compression of air in two or more stages.

NORDBERG-TODD UNIFLOW ENGINES

220. Nordberg Mfg. Co., Milwaukee, bulletin 30, 10x8 inches, 24 pages, illustrated. Discussion and description of engines suitable for driving generators for light and power plants that can be operated with any available steam pressure, super-pressure, back pres ure and vacuum. Equipped with simple one-piece valves that are tight without elastic or moveable seats or rings.

CORLISS ENGINES

221. Nordberg Mfg. Co., Milwaukee, bulletin 22, 8½x11 inches, 36 pages, illustrated. Describes special features of engines from 50 h. p. up that are economical of fuel, and discusses the long range, high speed and heavy duty valve gears, governors, bearings and some other special details.

THE SANITATION OF CITIES

222. The Sanitation Corp., New York City, 6 x 9½ inches, 120 pages, illustrated, heavy coated paper and embossed covers. A discussion by Wm. L. D'Olier and Staff, covering city plans and sanitary facilities, water supply and removal of sewage, purification of water supply, the sewerage system and various treatments, biological, mechanical, a development of commerial waterway is, as a sanitary measure and high pressure fire service.

The text is interesting, clear and free from technicalities. Numerous halftone illustrations, mostly of sewage treatment plants in American and foreign cities are given, and the book is a very attractive example of high class publication.

O. K. HOISTING MACHINERY

223. O. K. Clutch. & Machinery Co., Columbia, Pa., Catalog 19, 8 x 11 inches, 24 pages, illustrated, describing simple, efficient and durable hoisting engines, operated by gasoline, oil or by electric power.

SCHENK TIMBER CLAMPS

224. Concrete Devices Corp., 135 W. 3rd St., New York, leaflet, describing steel clamps for securing shoring and scaffolding timbers without bolts.

THE NORTHERN ROTARY PUMP

225. Northern Fire Apparatus Co., Minneapolis. Leaflet listing certain type of pumps, capacities of 50 to 1,000 gallons per minute and pressures of 50 to 700 pounds.

DAYTON-DOWD FIRE PUMPS

226. Dayton-Dowd Co., Quincy, Ill., bulletin 246, 11½x10½ inches, 16 pages, describes Dayton-Dowd underwriters centrifugal fire pumps approved by the Associated Factory Mutual Fire Insurance Companies and by a National Board of Fire Underwriters. Illustrated by diagrams and drawings of the pumps and by half-tones of them and of installations of large units in different cities. The pumps are automatically balanced, and have discharge and suction openings on the same sides.

HOISTING MACHINERY

227. Street Bros. Machine Works, Chattanooga, Tenn., catalog 24, 8 x 11 inches, 66 pages, heavy calendared paper. Illustrates and describes steam, gasoline, and electric hoisting engines; ship auxillaries, including windlasses, cargo hoists, steering gears, capstans and the like; together with guy, derricks, stiff leg derricks and elevated traveling derricks.

REPUBLIC TRUCKS FOR MUNICIPAL DUTY

228. Republic Motor Truck Company, Alma, Mich., catalog 8½x11 inches, 24 pages calendered paper and heavy covers. Catalog and specifications of 1, 1½, 2½ and 3½-ton trucks with drawings of general plans and elevations, decsriptions and details of special features and numerous half-tones of trucks furnished to different municipalities. Small accompanying leaflets show details of horizontal hydraulic dumping units and Wood-Detroit dumping units.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Public Works Journal Corporation
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 51 NOVEMBER 19, 1921 No. 21

Pennsylvania Highway Department

Developing a state highway system comprising more than 10,000 miles of the 100,000 in a state of 80,000 square miles. Adapting each road to its traffic. General rather than local interest rule in the Primary System; $50,000,000 are available for the present administration. Six hundred miles of new pavement the 1921 quota.

The state of Pennsylvania, with dimensions of 400 miles east and west and 200 miles north and south, has a total of 100,000 miles of highways, serving a population of about 10,000,000. The diversified typography of the state includes all kinds and conditions of surface with a large proportion of mountainous area under climatic conditions involving heavy rain and snow falls and severe cold in many parts of the state. This makes the highway conditions exceptionally severe, with sections in the northern part of the state in which concrete construction can be carried on for but a limited period on account of frosts.

As the interests of the state are mining, manufacturing, agriculture, and commerce, there is a great diversity of transportation requirements, including heavy freighting as well as the ordinary pleasure traffic and increasing exploitation of scenic routes through the state, which require a great amount of high-class highways, providing both for continuous traffic for their heavy loads and for high speeds, sometimes combined as well as at different times and in different localities.

Up to 1911 the highways throughout the state were entirely under the local control of counties, cities, and townships, the revenues originating by local taxation, but no system of main and connecting roads were then existent.

CREATION OF STATE HIGHWAY SYSTEM

In 1911 a state highway system was adopted by the legislature, embracing 8,800 miles, and at that time provision was made for the appointment of a highway commission and general organization. This highway system as legalized by the legislature was the result of a very comprehensive study by the commissioners and was intended to provide a system of short, improved connections between county seats and centers of populations; thus serving the many important agricultural and manufacturing centers. Additional lengths were provided where necessary to complete interstate, cross state, and through trunk lines, which substantially provide six north and south routes and six east and west thoroughfares with numerous radial lines connecting intermediate points. This system has since been modified occasionally by successive extensions, duly approved by the legislature, and until the system now comprises 10,200 miles.

PRINCIPLES OF FINANCING

The carrying out of this plan would ultimately involve the expenditure of very many millions of dollars. More than seventy millions have already been made available, derived from legislative appropriations, from current revenues, from the proceeds of a fifty-million dollar bond issue, and from Federal Aid, which has thus far amounted to thirteen millions of dollars.

It was recognized as fundamental that the proceeds of borrowed funds should be applied only to durable construction that will exist at the time of retirement of the bonds. It was, therefore, determined to restrict the application of the proceeds of bond issues entirely to types meeting these requirements, thus eliminating many temporary forms of construction that may be suitable for special cases or purposes and which are properly provided for by current funds. To issue a 30-year bond and construct a type of road that experience has shown will disappear in five years leads, in the opinion of the department, to bankruptcy. It is the belief of the department that the people of Pennsylvania have a right to enjoy their highways while they are paying for them and that their cost may be distributed over a generation.

Governor Sproul, inaugurated in 1919, is a man of wide business experience, and had taken a tremendous interest in the road system of Pennsylvania, authorized by the bill bearing his name. Believing that the improvement of the highway system is a business proposition, he appointed as commissioner, Lewis S. Sadler, who is not an engineer but whose executive capacity had been demonstrated in connection with the organization and functioning of the Pennsylvania Council of National Defence, and who was especially experienced in large scale financial business.

The first problem confronting the department was the method of apportioning the fifty-million dollar bond issue. There are in Pennsylvania 67 counties of varying size, population and assessed valuation, and naturally the counties that contributed most to the payment of the bond issue demanded the greatest mileage of improved roads.

After careful reflection the administration concluded to ignore all county lines and plan its work on a great trunk line system connecting centers of population, called the "Primary System," the whole cost of which would be borne by the state. This system comprises about 4,000 miles out of the total system of 10,260 miles. The department hopes under favorable conditions to complete approximately 2,000 miles by January 1, 1923, the end of the present administration.

GENERAL BENEFIT POLICY APPROVED BY LOCAL INTERESTS

In Pennsylvania, prior to 1919, as perhaps in most states with limited appropriations, it was utterly impossible for the department to meet even the small demands of the public for improvements, and naturally political influence was brought to bear upon the commissioner to advance this or that project. By 1921 such feeling throughout the state had to be corrected. Empowered by the legislature, the department was determined to construct the Primary System with a view solely to completing the plans and ultilizing the facilities for labor and materials offered in the particular sections of the state, rather than to meet the demands and influence of any particular community.

To that end, county commissioners and delegations of prominent and interested people from all sections of the state were invited to come to the office of the department at Harrisburg for the fullest discussion of their local problems and to learn the policy of the department. From January to June, 1919, 36,000 persons visited the department and were interviewed by the commissioner and impressed with the importance of operating along a definite plan, the first of which was the construction of the primary system at the sole cost of the state, and the second part of which was to develop a secondary system leading into the primary system, and composed of highways important locally but not to people of the state at large, the cost of which is to be borne by the local authorities. By this method of approach complete co-operation of the citizens of the state has been obtained. The various counties and townships have been bonded in considerable amounts to carry out this idea for secondary roads.

TYPES AND DIMENSIONS OF PAVEMENTS

The legislature gave the commissioner of highways the greatest freedom in selection of types of construction or sections to be constructed or sequence of operations. In making such decision the department, after an improvement has been authorized, makes a careful survey of the travel that the improvement is likely to bear. If there is promise of heavy truck travel, it is a rule that concrete shall enter in some form into the construction; if a road is to be subjected only to passenger traffic and that of small volume, a bituminous bound macadam road will be considered; but it is taken for granted that in the Primary System the entire mileage will be subjected to such traffic as requires the most durable type.

The width of 18 feet has been fixed as the minimum on the Primary System, with a berm of 3 feet on either side and 2 feet on either side for gutters. This width of pavement permits the easy and safe passage of two motor trucks of the maximum width permitted by law, i. e., 90 inches, without the necessity of trave'ing on the berms.

A road had been constructed of one-course reinforced concrete between Easton and Allentown, a distance of ten miles, commenced in 1916 and completed early in 1917. This road had been subjected to exceedingly heavy traffic during the period of the war and most careful tests of the 1,080 slabs composing it were made in order to come to some safe conclusion as to its durability. Three hundred and eighty cores were taken from this road by shot drills, and the specimens were found practically perfect, their surfaces showing almost no depreciation. It was concluded to adopt this type with some modification, one of the most important of which was to increase the weight of the reinforcing material and place it within 2 inches of the top.

WIDENING EXISTING ROADS

Traffic has developed to such an extent in Pennsylvania that it is apparent that the present width of most of the highways leading into the metropolitan centers is insufficient. Last year, in this state, the passenger cars made five billion car-miles and there are to-day more than 700,000 licensed motor vehicle registrations as compared with about 10,000 in 1911. Consequently, the legislature of 1921 authorized the widening of the right-of-way for state highways up to 120 feet where necessary.

The Engineering Division is now making a study of the roads leading out of Philadelphia. It is thought that it will be necessary to eventually widen the Lincoln Highway to 80 feet and to construct a pavement 52 feet wide providing for six-line truck traffic for a distance of at least 20 miles outside of Philadelphia. It is not proposed that this extension of width shall be physically accomplished at once, but plans will be filed which serve as notice to property owners, so that construction beyond the limits defined will be made at the risk of the property owners; by which method it is expected that millions of dollars will be saved at the future time when the physical widening shall be required for the convenience of the traveling public.

CONTRACTORS AND EMPLOYEES TREATED SOLELY ON THEIR MERITS

From the commencement of extensive construction, the department was naturally besieged by would-be contractors, endeavoring to secure contracts by political influence; but the commissioner has steadfastly conducted the work on strictly business principles of merit and competition, eliminating all influence and favoritism. He also has assumed supreme authority for hiring and firing employees of the department, whose work is judged solely by its results; merit and efficiency being recognized by advancement, and deficiency by demotion and dismissal. This applies to both construction and clerical forces and has naturally operated to the improvement of the morale, and to the selection and promotion of the most capable assistants.

POST-WAR FUNDS AND CONSTRUCTION

After the authorization of the state highway system, some construction work was commenced but on a comparatively limited scale so that, owing to the war conditions, up to 1919, only 180 miles of road had been constructed in which concrete was used for foundation or surface, although considerable work had been done in the construction of macadam surface of various types, all of which were built and maintained by the state department.

Bids were asked during 1919 for a large mileage; of which 680 miles were put under contract during the fall of 1919. Like other states, Pennsylvania then met conditions of shortages of labor and difficulties of transportation, and experienced an especially wet season, which retarded very materially its progress, but at the end of 1919, 255 miles of this modern type pavement had been completed.

The 1920 construction conditions were still more aggravating, caused by embargo orders of the Interstate Commerce Commission, forbidding the use of box cars and open-top cars for road purposes, and up to the last week of June, 1920, but 5 miles of surfacing was placed. In view of these discouraging conditions most states in the Union stopped all highway construction for the year. Pennsylvania, however, found itself with a thousand miles of its main arterial roads torn up, to the great inconvenience of the traveling public, and concluded to force its construction program at all hazards. With the aid of its Public Service Commission, it procured orders for 1,044 box cars per week for cement and 4,000 open-top cars for sand, gravel and stone, and by the end of the season had completed 413 miles of pavement.

In 1921, the construction season opened early and under favorable circumstances, and on the 15th of October there had been completed during the season 600 miles of modern type paving with the expectation that an additional fifty miles will be completed before the end of the season.

A very interesting feature in the offices of the commission is the graphic presentation of the road system on a large-scale wall map approximately 8 feet by 12 feet, on which the entire system of state highways is shown and lines of colored pins indicate the roads assigned for the improvement during the four years of the administration, with distinctive pins for each year's quota, for finished work, roads under construction and for detours, thus showing at a glance the detail condition of the entire system.

Old Wooden Highway Bridges

Seldom properly designed, built or maintained, intended for lighter loads than present practice, generally old and in dubious condition. Most of them invitations to accidents. Seldom advisable for greater than 15-foot spans.

The short span wooden bridges that are still to be found in almost all rural districts and in some suburban and even urban localities, may be picturesque and quaint, they may add some artistic touch to the landscape and they may even carry traffic, with limitations, but 99 per cent of them should be shot at sunrise, and the remainder should be held guilty of being unsafe or unsuitable until proven innocent, with the exception of a negligible proportion that may be found in mountainous and heavily wooded regions where timber is large and abundant and traffic is very light.

The indictments against ordinary wooden highway bridges contains many serious counts; they are seldom properly designed and proportioned.

They are seldom well built of first-class materials.

They are seldom properly inspected and maintained.

They are almost invariably intended, so far as any acceptable designs go, for very much lighter loads than the maximum likely to be imposed.

Most of them are of dubious character on account of their age and infirmities, since for years the tendency has been to make all new bridges and replace old ones with steel or concrete.

Less than three years ago the state highway department of Pennsylvania announced that "all bridges on the state's primary system, for which the state is responsible, are to be rebuilt."

As this broad statement included not only wooden, but iron, steel, concrete and stone bridges the replacement obviously could not be immediately carried out, and on the little traveled roads, although they may not be of the primary state system, there are doubtless many bridges still in service in Pennsylvania, and in most other states, that correspond to the group of old set-

QUEEN POST TRUSS POORLY FRAMED AND ON DILAPIDATED ABUTMENTS

tlers illustrated by the accompanying pictures, selected from the files of the Pennsylvania State Department of Highways, merely to illustrate the general character and appearance of many old hit-or-miss structures still in service and, in Pennsylvania at least, being replaced as fast as may be with real bridges of girder or arch type, whose appearance, as in the single example herewith, especially when contrasted with such wooden bridges that have managed to get by for a long time, inspires confidence in the strength, stability and durability of concrete structures.

A concrete bridge, built with anything like proper design and supervision will, to be sure, cost much more than a makeshift wooden bridge, but in the end will be far more economical on account of the practically unlimited life, lack of maintenance expenses, capacity for any possible loading, and the assurances that it gives against losses by flood or fire or damages to itself or traffic.

Although the old wooden bridges illustrated indicate effort to make the simplest possible type of truss construction, namely the king-post or queen-post truss, they show, except in the case of the covered bridge, where the details are hidden but suggestively better, a most lamentable lack of any idea of adequate proportioning, detailing or workmanship so that the pretence of trussing probably adds the lowest minimum to the strength of the horizontal members as girders and may indeed diminish it.

The dilapidated substructures have their counterparts all over the country, and are an invitation for a wash-out in the first heavy freshet or destruction by running ice. If these perils are escaped there is always more than possibility that the decay visible or concealed or weather-checks, or both, are progressively reducing the original strength of the bridge so that some day it will suddenly fail under loads that it has heretofore carried.

It is by no means impossible to build an excellent wooden short span bridge, but the moment it exceeds a 15-foot span its design, construction and maintenance should be in the engineering department and in most cases such a bridge should nowadays be built only for emergency, for very light traffic where conditions are such that there is not danger of their use by automobiles, trucks or road machinery, or for temporary service such as that of a short period by-pass or detour.

CONCRETE GIRDER SPAN WITH HEAVY MASONRY ABUTMENTS AND WING WALLS

Essentials of Wooden Highway Spans

Restricted selection of type and dimensions. Correct design. First-class materials and workmanship. Proper inspection and maintenance. Restriction of traffic.

In general the use of wooden highway bridges should be entirely prohibited in cities and large towns and should be permitted only for temporary service or for very short spans and light selected traffic, or for emergency or for very remote or mountainous districts in other places.

Steel and concrete bridges can be made far stronger, more reliable and more durable, are, when well built, less subject to injury and deterioration, are likely to be better built and designed and are less likely to fail from overload.

The use of wooden bridges is a standing temptation to every carpenter, wood butcher and construction foreman or town commissioner to be his own engineer and mechanic, to work without proper supervision, to build in ignorance or regardless of present essentials and future requirements, and is likely to be responsible for hasty construction, inadequate strength and the use of poor materials badly fabricated.

Generally these bridges are most permissible for very short spans over small brooks, for replacing culverts or over swamps or narrow valleys where they are supported on pile bents up to a maximum of 16 feet apart. In such cases they may be made of heavy timber, forming simple full length girders, used in pairs and multiples of pair laid close enough together to carry any load that can possibly be permitted to be imposed. Ordinarily the length of spans would be limited by the available length of large sawed timber to make the tension member of the truss, preferrable of the king-post or queen-post type, which will usually suffice for the unspliced chords.

For longer spans no safer or more durable wooden construction has been devised than the old-fashioned Towne lattice girder, put together with wooden pins and protected by a shingled roof. Many of these have been replaced by light steel trusses that were neither as strong, as rigid, as durable or as economical as the old wooden spans. The ordinary limit of length for this type was about 100 feet and the principal difficulties encountered were in securing proper camber, lateral bracing and adjustments. Still longer spans have been successfully built with combination Howe trusses, but these may be objectionable because of the comparatively large amount of steel and cast iron required for tension members and details. At the present time their use will be seldom justified, except in very heavily timbered or mountainous localities.

For ordinary spans up to 20 or 30 feet, king and queen-post trusses are simple, efficient and are easily constructed from moderate size timber with single piece lengths for bottom chords and screw end rods for vertical tension members. Care should, of course, be taken to have the inclined and horizontal members of the truss properly proportioned for their respective stresses, the ends should be carefully seated to full bearing, with hard wood blocks or castings to receive the nuts and washers of the vertical rods.

At panel points and sometimes at intermediate points the floor beams should be rigidly secured to the lower chords and project beyond them to receive the ends of sturdy, well-fitted inclined struts, bracing the trusses in vertical planes.

The ends of the trusses should have ample bearings, carefully adjusted on smooth horizontal stone or concrete surfaces, or on heavy timber sills, and in either case they should be well exposed to light and air and thoroughly drained.

KING POST TRUSS WITH SLENDER TOP CHORDS

The floor should consist of heavy hardwood planks carried on transverse floor beams or for very narrow roadways, may be supported directly on the lower chords of the trusses when the latter are especially proportioned to carry both bending and compressive strain. The floor planks and beams should never be proportioned by guess, but the sizes and spacing should be accurately determined by selection from tables of strength that are found in all engineering handbooks. The floor planks should be securely spiked in place and economy and durability may often be promoted by making the floor in two layers so that the upper course may be worn very thin before renewal without impairing the strength of the lower course whose life can thus be greatly prolonged and the cost of renewal be decreased. In this case the lower course should be laid with clearance between the boards for ventilation and drainage and the upper course may be laid diagonally, giving great additional lateral stiffness to the bridge.

KING POST TRUSS WITH POOR DETAILS

It should be kept in mind that the floor is the weakest part of the bridge and must be proportioned for the heaviest possible concentration of live load at all points, and for maximum loading throughout.

Care should be taken to have the road grade descending, if possible, from both ends of the bridge to avoid excessive impact of sudden loads; the bridge should be transverse to line of the street if possible; should be well protected by substantial handrails, wheel and hub guards, and should have prominent notices regulating traffic and speed.

A clear and complete plan and elevation of the bridge should be provided together with the record book with proper instructions, headings, and rulings for periodical inspection that should be made every three or six months by a reliable carpenter foreman, and at least once a year by an engineer. The inspection should give particular attention to the stability of the piers and abutments, the nature of the bottom and any indications of scour or danger from freshets, noting any repairs to the masonry or wing walls. Special pains should be taken to examine all of the bearings of the trusses, beams and girders and their joints and connection at all places where there is a possibility for moisture to collect or dirt and rubbish to gather. These places should be cleaned and dried and, if necessary, provided with drainage for snow and rain water.

The timber should be carefully examined for decay and large pieces should occasionally be bored with a small bit to determine whether they are sound throughout. Bolts and screw rods should be kept adjusted, but not too tight, iron

QUEEN POST TRUSS COVERED BRIDGE

and steel rods, nuts and washers should be painted, but no paint should ever be put on the timber. Defective floor planks should be replaced as soon as noted and if repairs to the trusses themselves are needed they should be made under engineering supervision.

If the passage of loads heavier than the bridge is designed for is unavoidable, heavy longitudinal planks should be provided to distribute the wheel loads over the floor, and the latter should be shored up at panel points or under the girders at short intervals if the bridge is of simple girder construction.

Maintenance of Sewerage Systems

Some features from Baltimore practice—obstructions, catchbasins, manhole covers, lamp-holes, flush-tanks, pumping stations, etc.

In a paper before the American Society for Municipal Improvements, Milton J. Ruark, division engineer of sewers of Baltimore, discussed at some length many of the features of maintaining the sewer system of that city which seemed to deserve special mention or offer valuable information for others in charge of sewerage systems. The sewers and storm water drains of Baltimore were built almost entirely between the years 1906 and 1916 and therefore have an average age of about ten years. The following is an abstract of his paper:

Obstructions.—Perhaps the chief aim of the engineer in charge of a sewerage system is to maintain it free of obstruction and odors. Designing sewers with sufficient grade does not necessarily insure this, for even more important than grade is the selection of a good quality of pipe and the skilful laying of it. The pipe should be smooth and straight and laid in continuous straight alignment between manholes, with each joint made as tight as practicable.

One of the chief causes of obstructed sewers is tree roots. Tight joints greatly reduce the probability of obstruction of sewers from this cause. Poplar trees are those responsible for most of this trouble in Baltimore. Because of this and because poplar trees have little value as shade trees a Baltimore ordinance prohibits further planting of them. Root obstruction occurs more frequently in house connections than in the street sewers. Roots have not caused obstructions in storm water drains, probably because they carry little or no flow during dry weather. Roots find their way into sanitary sewers, however, even where bituminous joints have been used.

Catchbasins.—"With the exception of a few low-lying drainage areas, there are no catchbasins in Baltimore and it is not likely that any will be built in the future. Most of the storm water drains are self-cleaning, and the building of catchbasins would therefore serve no useful purpose but they would probably become nuisances. Catchbasins are very expensive to clean out. They soon fill up with silt and it is difficult if not impossible to prevent street sweepers from disposing of street sweepings in these inlets in order to lessen their labor. Furthermore, catchbasins often retain a good deal of decomposed matter and they cause complaints because of odors and prevent a free circulation of air through the drainage system."

Manhole Covers.—Covers for manholes on sanitary sewers and for those on storm water drains should be clearly marked so that any municipal employee can tell which kind of a sewer it covers, and in addition the size should differ so that the covers cannot be interchanged. Unless this is done there may be much confusion in maintenance work, and other troubles may arise, such as the dumping of snow into the manholes of small sanitary sewers under the impression that it is being deposited in storm water drains.

When the Baltimore sewers were first built, each cover was provided with six one-inch holes for ventilation. Later all but two of these have been omitted, these two being left for use in removing the cover, since the omission of traps on house connections provides ample ventilation of the sewers without using the manholes for this purpose. The elimination of these openings prevents considerable surface water from flowing into the sewer and adding to the cost of treatment of the sewage.

Complaints have been made because of loose manhole covers which rattle when traffic passes over them. It has been found at Baltimore that the best remedy for this is to have all manhole frames and covers inspected at the foundry and accept only those that fit well. The city buys the heads and covers and furnishes them to the contractors.

Lamp Holes and Standpipes—Some lamp holes were included in the Baltimore sewers when first built, but they have been discontinued as they are of little or no value for clearing the sewers and seldom facilitate maintenance work in any manner whatever; while the covers are so light that they are removed by children, who drop sticks and rubbish into the sewers through them; and in addition the lamp hole, no matter how carefully constructed, is apt to settle and break away from the lateral sewer.

Standpipes as part of the house connections in deep sewers have also been the source of much trouble, owing chiefly to settlement.

Garage Connections—It is unlawful in Baltimore to conduct garage floor drainage into the sanitary sewers and there has been no record of explosions in any of the Baltimore sewers. Such drainage can be connected to the storm water drains, the plumbing regulations requiring, however, that an approved trap of ample capacity be installed on the house side of the sewer connection so as to intercept any gasoline or oils that might otherwise flow into the storm sewer.

Flush Tanks and Flushing Connections—Originally 1½-inch taps from the water mains to each terminal or dead-end manhole were constructed to permit flushing the sewers when necessary. This practice has been discontinued as it has been found that flushing is necessary only occasionally, and that the connections often rust out and become leaky in a short time. Flush tanks also are no longer used except at the heads of very flat grades, and Mr. Ruark questioned whether they were desirable even there. There have been few complaints of deposits in sewers at or near the upper ends of the laterals.

In Baltimore four men spend all their time making periodical inspections of manholes and removing from manhole benches such things as sticks, rags, bottles and other materials that might choke the sewer. When they find sewers partially obstructed, they immediately have these obstructions removed, which prompt attention reduces the annual expenditure for cleaning sewers and also reduces the complaints of flooded cellars.

Sewage Pumping Stations—The main pumping station at Baltimore pumps an average flow of 25 million gallons a day, which has reached a maximum of 38 million, and has been in continuous service without interruption since it was installed. The writer calls attention to the necessity of securing such continuity of service, any interruption of which would be a serious calamity. This necessitates duplicate apparatus kept in condition for instant satisfactory service.

The Baltimore station has also demonstrated that a sewage pumping station can be operated in the midst of a congested district and the sewage screenings disposed of therein by incineration without causing a nuisance.

In conclusion, Mr. Ruark remarks that while great advances have been made in sewer design during the past ten or fifteen years, much remains to be done. "Engineers should ascertain with a greater degree of accuracy the value and advisability of using concrete for sewers as compared with terra cotta vitrified pipe; the effect by various kinds of sewage and industrial waste flowing under different velocities and conditions in both concrete and brick lined sewers, and the life of these materials under such conditions. Engineers should, as a matter of public service, make a more detailed study of the storm water run-off from various kinds of pavements, etc., the percentage of water entering different types of inlets under varying surface grades and conditions."

Creosoted Timber for Highway Construction

The Bureau of Public Roads, United States Department of Agriculture, has recently instructed its engineers to use timber creosoted by the vacuum and pressure methods where justified on economic grounds. The instructions issued in January practically prohibited the use of timber for highway construction purposes and were generally considered by state, county, city and other engineers to mean that the government disapproved of the use of well-creosoted timber. The recent instructions state that:

"The economic advantages of trestle construction in some sections of the country are so clear and local timber supplies are sometimes available on such terms as to make it advantageous to use timber for long bridge approaches across river bottoms or for swamp and marsh crossings. The statement of policy made in the general letter of January 20, 1921, is to be adhered to, but where under that letter the district engineer is prepared to recommend the use of timber, the bureau will not question the use of creosoted material where the following conditions are observed:

"Timber trestles or bridges constructed of creosoted material treated by the vacuum and pressure method.

"Timber floors constructed of creosoted planking treated by the vacuum and pressure method, laid laterally with a plain or tank treated wearing floor ('half-sole'); or laid laterally or longitudinally on edge, spiked together, and covered with a mastic wearing course.

"Timber floors for light traffic where single floors are laid and not protected by any covering constructed of tank-treated material or plain material depending on whether plain timber is more likely to rot out or wear out.

"This communication is not to be construed as an endorsement of this type of construction, or to let down the bar to its general use, but to define procedure when conditions of traffic and economy require consideration of timber construction.

"P. ST. J. WILSON,
"Chief Engineer."

Large Church Moved for Street Widening

By E. Dauenbauer*

The 4,500-ton brick St. Nicholas Church, Pittsburgh, raised 8½ feet and moved 20 feet horizontally without interrupting the services.

Owing to the widening of East Ohio street, N. S., Pittsburgh, Pa., the St. Nicholas R. C. Church building had to be moved back 20 feet. The 65 x 110-foot building is of heavy brick construction with large towers on two corners. The slate roof is supported by the outside walls and by eight columns in two rows. The interior of the walls, the Altar, Sacristy and the arches are all beautifully decorated. The windows are of art glass. Approximate weight of building, 4,500 tons.

As the church was built against a steep hillside, it was necessary to remove about 3,000 cubic yards of earth with a steam shovel to provide clearance in the rear for its new position.

The building was loaded on twelve 14 x 16-inch running timbers on top of which other timbers were placed transversely, and upon these the walls of the building were supported by 8-inch steel I-beam needles placed in clusters of 2, 3 and 4 approximately 3 feet from center to center.

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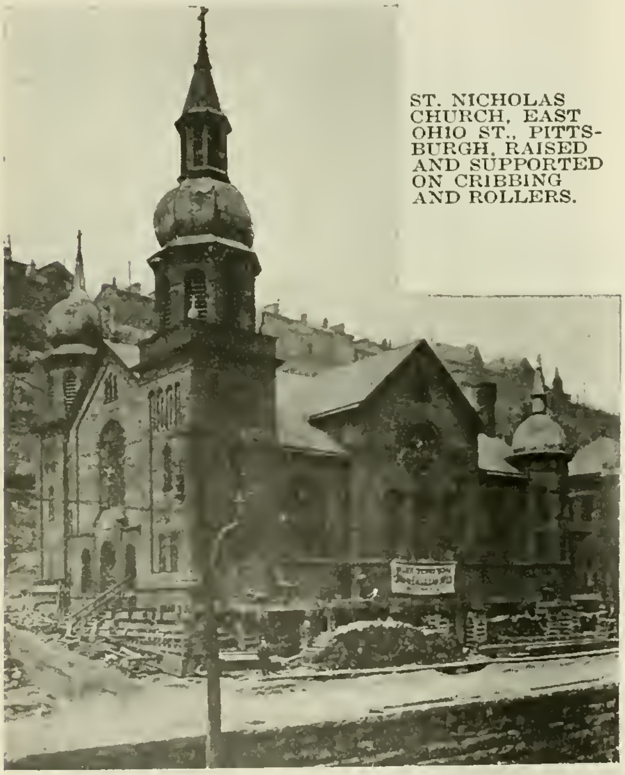
*Of the John Eichleay, Jr., Co., Pittsburgh.

Eight hundred 20-ton jack screws were then placed on cribbing directly under the 12 running timbers and the building was raised 8 feet 6 inches. Eighty-five-pound steel rails were placed on the twelve lines of cribbing, and 1,000 3-inch steel rollers with steel plates over these were set directly under the running timbers, the jack screws were released, and the building was ready for moving.

This was accomplished by ten drums containing jack screws placed against the running timbers and operated by hand bars. The 20-foot move was accomplished in 18 hours. The building was then taken on jacks again and set level and plumb. New foundation walls were built, the building securely underpinned and the timbers, I-beams and jacks removed.



ST. NICHOLAS CHURCH, EAST OHIO ST., PITTSBURGH, RAISED AND SUPPORTED ON CRIBBING AND ROLLERS.

Special care had to be exercised to keep the building level and plumb at all times to prevent cracking. This was done by checking up with an instrument to remedy any settlement that might have occurred.

The entire operation was accomplished without damage. All services were held as usual, lighting, heating, sanitary services and temporary means of entrance during the progress of the work were maintained.

University of Michigan's Highway Course

The University of Michigan has made public its 1921-22 schedule of short period advanced courses in highway engineering and highway transport. These courses are intended for men actually engaged in the practice of highway engineering and highway transport and each extends over two weeks. Five two-weeks' courses extend in continuous succession from December 5 to February 10, a sixth from February 20 to March 3, and the seventh from March 6 to 17. The instruction is to be given by Professors Blanchard, Smith, Bateman, Riggs, Lay and Gram.

The seven courses are as follows:

1. "Earth, Sand-Clay, Gravel and Broken Stone Roads." "American and English Highway Transport Methods."
2. "Highway Engineering, Financing, Management and Organization." "Highway Tranport Legislation and Traffic Legislations."
3. "Grading Machinery and Oporations." "Interrelationship of Highway, Railway and Waterway Transport."
4. "Bituminous Surfaces and Bituminous Pavements." "Highway Transport Costs and Record Systems."
5. "Mechanism, Operation and Maintenance of Motor Trucks, Tractors and Trailers." "Highway Laboratory Research." "Highway Structures." "Highway Transport Management."
6 "Highway Transport Economics and Surveys." "Brick, Cement-Concrete, Stone Block and Wood Block Pavements."
7. "Highway Specifications, Contracts and Jurisprudence." "Highway Engineering Seminar." "Highway Engineering Theory and Design." "Highway Transport Seminar."

New Centrifugal Pumps for Chicago

Two 60,000,000-gallon turbine-driven pumps selected on considerations of operating cost, experience and financial rating of bidder, time of shipment and design.

The Springfield Avenue station, which is one of a group of large stations supplying water to the city of Chicago, derives its supply from the northwest tunnel system, and several years ago had an average daily pumpage of 75,000,000 gallons and a maximum of 170,000,000 gallons, distributed over a residential district covering about 33 square miles in the western part of the city.

The equipment in 1919 consisted of three 20,000,000 and one 40,000,000-gallon vertical, triple expansion pumping engines and one 25,000,000-gallon, turbine-driven, centrifugal pump, all designed to work against a total head of 125 feet.

As the population increased and the demands upon the station became greater, it became increasingly difficult to maintain the required pressures.

After a study of the then existing conditions, it was decided to remove one of the old 20,000,000-gallon reciprocating pumps and install two 60,000,000-gallon, turbine-driven centrifugals designed to work against a total head of 150 feet. When completed, these two 60,000,000-gallon pumps, working at their most efficient rating, will meet the entire maximum demand upon the station and maintain the required pressures throughout the district.

The main pump of each unit is a De Laval centrifugal with a designed capacity of 60,000,000 gallons per 24 hours against a total head of 150 feet. A De Laval steam turbine drives the pump through a set of De Laval gears. The turbine operates at 3,800 r. p. m. and the pump at 530, giving a reduction of 7.2 to 1. Steam is supplied at 175 pounds pressure and 150 degrees Fahrenheit superheat. The circulating pump, which is operated on an extension of the main pump shaft, has a capacity of 3,500 g. p. m. against a head of 12 feet. Each unit, including all its auxiliaries, is guaranteed to develop not less than 152,000,000 foot-pounds of work per 1,000 pounds of steam.

The turbine exhausts into a C. W. Wheeler surface condenser 54 inches in diameter and 19 feet 3 inches long with 4,550 square feet of surface in the tubes. The air and condensate pumps were also supplied by the same company. An atmospheric exhaust valve is provided.

The equipment described is being installed with day labor by the Bureau of Engineering of the city of Chicago, under the general direction of Alexander Murdoch, city engineer.

The new pumps each occupy a great deal less space than the reciprocating pump they replace, as is indicated by the diagram of one of the new pumps and one of the old pumps of only two-thirds its capacity.

In selecting the 120,000,000-gallon pumps, turbines, and gears, the choice between bids was made on a consideration of operating costs estimated on the annual fixed charges taken at 10 per cent of the bid price, and of the duty guarantee under normal operating conditions; the experience the bidders had had in manufacturing similar machinery that includes at least one water works pumping unit of approximately the same size for each of three different cities, all of which have been in regular service for three years; the dates of promised shipments of plant to Chicago; and the characteristics and details of design as indicated by the principal drawings and by curves showing the pump efficiency and brake horse-power for a range of pressure heads from 80 feet to 160 feet. No bids were considered that did not guarantee a minimum duty of 130,000,000 foot-pounds per 1,000 pounds of steam.

Each unit consists of a steam turbine, a reduction gear, a main centrifugal pump and a circulating centrifugal pump connected together with flexible couplings of the "pin and bushing type."

The turbine is of the horizontal shaft, multiple-stage, impulse type, developing the full rated capacity of the pump at 4,000 r.p.m. with a peripheral speed, at the centers of the buckets, not exceeding 650 feet per second under any condition.

The turbine is built for normal steam conditions of 175 pounds guage and 150 degrees superheat and 28½ inches vacuum and is capable of operation to full rated capacity with pressure of 150 pounds and 100 degrees superheat or under maximum conditions of 210 pounds i.s.p. and 200 degrees superheat at turbine inlet.

The casing is split horizontally and arranged to permit removal of top half without disturbing steam or exhaust connections.

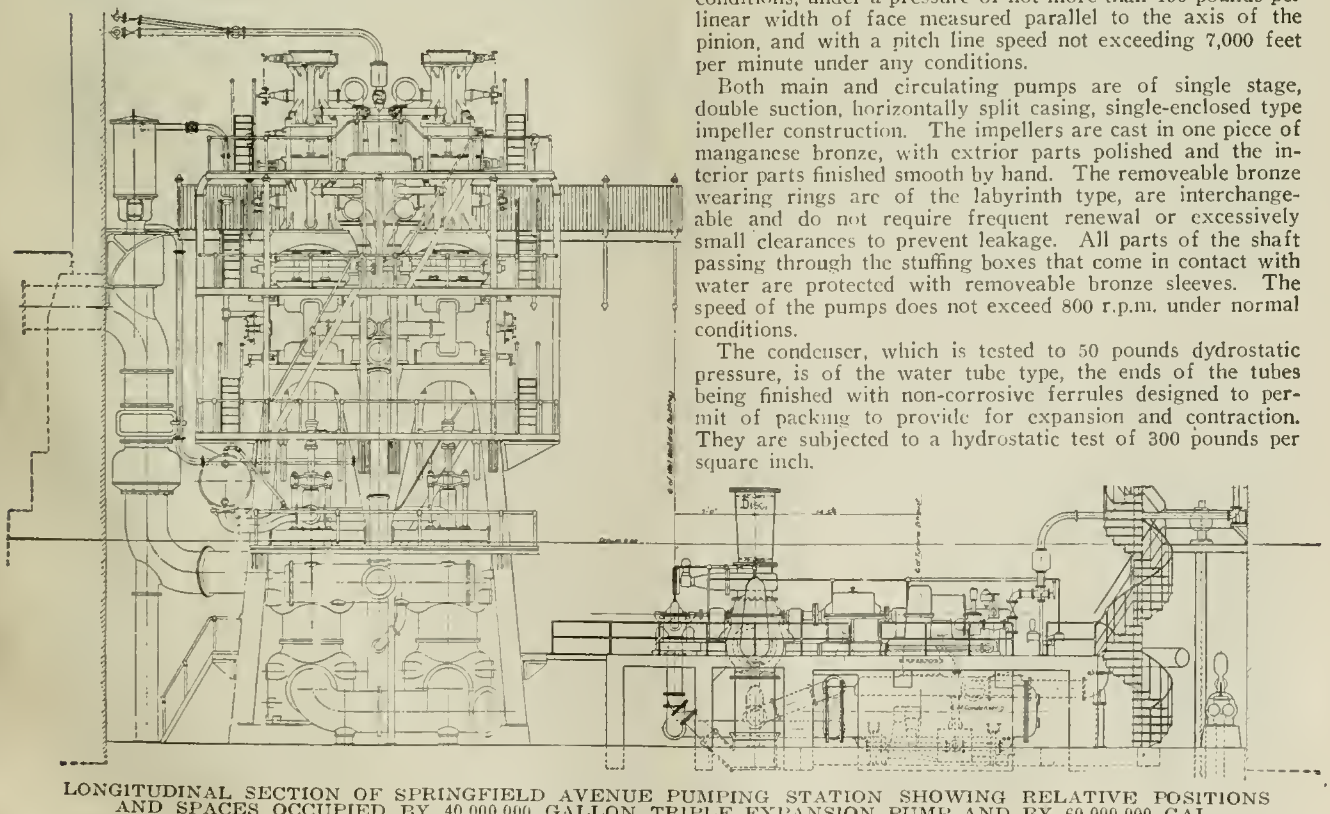
The buckets, nozzles and guide vanes are renewable. The turbine wheel and shaft are cable of operation up to 10 per cent above normal. All bearings are split in half and are designed for forced lubrication.

While the turbine is in operation its speed can be adjusted within limits of 5 per cent above or below normal and within a variation of two degrees either side of the adjustment speed.

The reduction gears are of a type that have been proved durable and efficient under continuous waterworks or power plant service of three years. They are of the double helical type with polished teeth operating under normal conditions, under a pressure of not more than 400 pounds per linear width of face measured parallel to the axis of the pinion, and with a pitch line speed not exceeding 7,000 feet per minute under any conditions.

Both main and circulating pumps are of single stage, double suction, horizontally split casing, single-enclosed type impeller construction. The impellers are cast in one piece of manganese bronze, with extrior parts polished and the interior parts finished smooth by hand. The removeable bronze wearing rings are of the labyrinth type, are interchangeable and do not require frequent renewal or excessively small clearances to prevent leakage. All parts of the shaft passing through the stuffing boxes that come in contact with water are protected with removeable bronze sleeves. The speed of the pumps does not exceed 800 r.p.m. under normal conditions.

The condenser, which is tested to 50 pounds dydrostatic pressure, is of the water tube type, the ends of the tubes being finished with non-corrosive ferrules designed to permit of packing to provide for expansion and contraction. They are subjected to a hydrostatic test of 300 pounds per square inch.



LONGITUDINAL SECTION OF SPRINGFIELD AVENUE PUMPING STATION SHOWING RELATIVE POSITIONS AND SPACES OCCUPIED BY 40,000,000 GALLON TRIPLE EXPANSION PUMP AND BY 60,000,000 GALLON STEAM TURBINE DRIVEN CENTRIFUGAL PUMP.

There is a rotative crank and fly wheel dry vacuum pump with waterproof cylinders, and there are two duplex, direct acting condenser pumps for alternate service. The speed is controlled by a valve operated by a float in a damper attached to the condenser hot well and does not exceed 15 feet per minute under normal conditions.

The two pumps deliver the condensate against a head of 75 feet and, with the condenser, are designed to make a vacuum of not elss than 28½ inches under normal conditions with water entering at 70 degrees with a terminal difference of not more than 10 degrees, and with 1 square foot of surface for 5 pounds of steam consumed per hour by the main unite and all its auxilaries.

The equipment installed was tested by the manufacturer at the shop for pressure, overspeed, and balance, and the pumping units were assembled and subjected to efficiency tests at the shop.

At the end of the 30-day probationary period the city will conduct field tests of not less than four hours and not more than ten hours' duration to demonstrate capacity and duty. The units will then be required to deliver not less than 41,677 gallons per minute throughout the duration of the tests. The result for duty tests will be corrected for variations from normal steam, superheat and water temperature in accordance with correction curves furnished by the bidder with his proposal. In case the results of the field tests show an actual duty development less than the guaranteed duty, the equipment may be accepted at a reduction in price equal to five times the difference between the annual fuel charge based on the duty obtained by the field test, and the annual fuel charge based on the guaranteed duty. No unit will be accepted if the duty developed during field test is less than 130,000,000 foot-pounds per 1,000 pounds of steam.

City Commissioners Recalled

Bay City, Mich., recalled four city commissioners October 11 by more than 600 majority, the principal reason assigned being that the commission had appointed an out-of-town man as city manager, which manager has not proved popular with many of the citizens. The election to fill the vacancy will be held shortly and it is understood that all four of the recalled commissioners will be candidates for re-election.

Road Work in North Carolina

State Highway Commissioner Frank Page and State Highway Engineer Charles M. Upham are proud of the record of the past six months' work in North Carolina. Beginning with contracting for 34 miles in July, the August lettings amounted to 41 miles, September to 85 miles, and October 130 miles, while it is expected that about 150 miles will be let in November. At present 80 contractors employing 6,500 men are at work on 896 miles of road, 3,200 men are working in rock quarries and gravel pits in connection with the road work, and 900 are employed in maintaining 4,500 miles of road. The highway commission was organized in May of this year and by the end of its first fiscal year expects to have a total of 1,500 miles under construction and 5,000 under maintenance.

Paving Brick Specifications

The Committee on Specifications for Brick Paving of the A. S. M. I., in reporting to the Baltimore convention, stated that it had rewritten the paving specifications in an effort to bring them up to date and provide for the construction of the best type of brick pavements.

The committee quotes from an editorial in Public Works on September 17 as follows: "With demands for wire-cut brick, repressed, sharp edges, rounded edges, vertical fibre, etc., it does not seem possible that one standard can be adopted, but it does seem perfectly feasible to reduce the number to three or four, and it is to be hoped that such will be the result of the combined efforts of the various associations and departments now working to this end," which opinion the committee agrees with.

The committee considered carefully and at length the advisability of providing specifications for a plain wire-cut brick without lugs, for use with an asphalt filler applied by the squeegee method, having been informed that this type has been used in certain sections of the country and is being specified by engineers in still other sections. It decided, however, to consider the matter for another year and investigate the type of construction before including it in the specifications.

"Specifications for a tar mastic and also for an asphalt mastic bed were considered. The committee was informed of the development in recent years of this type of construction, but also decided to hold this subject open for another year to give opportunity for further observation and investigation of this type of construction.

"It is of special importance that brick pavements be placed upon the particular foundation best suited for economy and service of the pavement; that is, when a rigid base is used, the brick wearing surface should be either a rigid type with cement grout filler of flexible type with soft filler. When the flexible base (all other materials except cement concrete) is used, then only a flexible type of wearing surface should be used. The judgment of the engineer should be depended upon to properly adapt and adjust the principles as well as the details of construction to the variable conditions which confront him, not only in his city as a whole, but in each separate project.

The committee consisted of George F. Fisk, assistant engineer in charge of paving construction of Buffalo, as chairman, and D. B. Davis, E. B. Ulrich, Edward E. Duff, Jr., and E. A. Fisher.

The new specifications differ quite a little in arrangement and in some details of actual requirements from those previously recommended by the society. Hillside, both repressed and wire-cut, and wire-cut bricks with lugs are provided for, as well as repressed with lugs. In the rattler test the variation in loss is reduced to 6 per cent in the brick from any one factory, and losses of 22, 24 and 26 per cent on 3½ x 4 x 8½ brick are provided for heavy, medium and light traffic streets, respectively.

PUBLIC WORKS
Published Weekly
by
Public Works Journal Corporation
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba..$3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

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Tunneling Efficiency

Although tunnel construction is likely to be often dangerous, uncertain, costly and slow and to involve elaborate and expensive methods of appliances, there are occasions when tunnels, especially those of small diameter, can be driven rapidly and safely with simple methods and equipment if favorable conditions are predetermined and the work is handled by a competent contractor under careful supervision, as is the case with the Milwaukee water supply tunnel, to be described in our next issue.

Here the engineer and contractor have successfully co-operated and the work has advanced steadily, without accident, with a small force and simple standard appliances. Sufficient time having been allowed for the execution of the work it sufficed to provide construction plants at only one of the two shafts and shift it to the other shaft when the proper proportion of work had been done at the first shaft, thus saving considerable outlay for equipment.

Although the ground encountered was generally good solid clay there were treacherous places where the use of compressed air was an important safeguard against falling roof and also helped to prevent an undue inflow of ground water and the tunnel has therefore been driven under a moderate air pressure, but without the greatly increased expense of installing and operating a hydraulic shield that would necessarily have made the work much slower.

Another economy was effected by making the concrete tunnel lining itself a part of the air lock in combination with transverse steel bulkheads, and it was considered that the loss of air occasioned by the extra length of the air lock, was compensated for by the greater rapidity and convenience of passing materials through it than through a much shorter steel lock.

Ample and continuous protection from falling roof was provided by the use of special arch timbering made of heavy planks battened together in pairs and rapidly adjusted when necessary by wedges at the joints of the segments.

The excavation was greatly promoted by the use of pneumatic tools for penetrating the very hard clay, which was subsequently easily pried off without the delay, danger or expense of blasting and without involving the removal of poisonous gas or powder fumes.

The timely detection of poisonous or explosive gases, which fortunately have not yet appeared, has been provided for by the daily tests of samples of the tunnel's air, which, although of a negative nature, are quickly and easily made and are considered ample to give timely warning of danger.

What Can a Health Department Do?

One of the most important duties and responsibilities placed upon the boards of health of many of the states is that of protecting the general health by securing the construction of sewage treatment plants. In some cases moral suasion is sufficient to secure such construction, but it is becoming apparent that health boards must be provided with some power and authority to compel compliance with orders for construction of sewage treatment that it may give to the several communities of the state.

In some states the health board has exerted pressure by refusing to permit a city to construct any more sewers until it has built a disposal plant. In at least one Pennsylvania city of considerable size, no sewers for receiving house sewage have been constructed during the 15 years since the state health board made such a ruling, because the people will not vote the necessary funds for building the sewage treatment plant. The failure to provide sewers for the newly developing sections of the city, as well as for the considerable number of older sections where such sewers had not previously been built, is undoubtedly causing to an increasing extent an insanitary condition in that city. It would seem as though some way might be found for permitting the health board to bring pressure on a city in some way that does not itself threaten the health of its citizens.

Another difficulty that sometimes rises is illustrated by a statement made elsewhere in this issue of Public Works. A New Jersey town, ordered to build a sewerage system, calls to the attention of the state board the fact that to do so would necessitate its raising more money by a bond issue than it could do without exceeding the limit of indebtedness established by state law.

It suggests itself that conditions such as the latter one described, and possibly the other also, might be met by the plan of having the state give to the state health board the power and the necessary credit to permit it to construct itself any plant which a town will not or cannot provide at the order of the board, charging the cost of the same against the town with reasonable interest and allowing the town a certain number of years to pay the indebtedness to the state thus incurred.

In this connection it may be recalled that in Pennsylvania it was proposed a few years ago that, in view of the fact that a sewage treatment plant is of much more benefit to other citizens of the state than to those of the city that erects it, a part of the cost of all sewage treatment plants (50 per cent was suggested) should be borne by the state at large. There is much to be said in favor of this proposal.

It is greatly to the credit of both Pennsylvania and New Jersey and of a number of the other states of the country that scores of cities, towns and villages have installed sewage treatment plants either of their own volition or in willing compliance with the requests of their state health boards; but it is apparent from a number of instances similar to those above that in order to meet such recalcitrant communities, state health boards should be given more power and authority, to be used only as a last resort.

Robert Louis Stevenson on Engineering

Among the very best of the annual reports issued by municipal departments that reach this office are those of the water Commissioner of St. Louis, Edward E. Wall. One feature of these reports that always attracts our attention is not a part of the report at all, but is a quotation from some author of high repute which has direct interest for the engineer or water works man and is printed immediately preceding the report. That found in the report for 1920-21 is given below because of its keen analysis and clear, brief statement of an important element of engineering. Most of our readers do not need to be reminded that Robert Louis Stevenson was the son of a famous British engineer, and perhaps would have himself followed that profession had not his weak constitution interfered to make him the best loved writer of the finest English of the last half century.

* * * And in truth what the engineer most properly deals with is that which can be measured, weighed and numbered. * * *

These are the certainties of the engineer; so far he finds a solid footing and clear views. But the province of formulas and constants is restricted. Even the mechanical engineer comes at last to an end of his figures and must stand up, a practical man face to face with the discrepancies of nature and the hiatuses of theory. After the machine is finished, and the steam turned on, the next is to drive it; and experience and an exquisite sympathy must teach him where a weight should be applied or a nut loosened.

With the civil engineer the obligation starts with the beginning. He is always the practical man. The rain, the winds and the waves, the complexity and the fitfulness of nature are always before him. He has to deal with the unpredictable, with those forces that "are subject to no calculation"; and still he must predict, still calculate them at his peril. His work is not yet in being and he must foresee its influence; how it shall deflect the tide, exaggerate the waves, dam back the rainwater or attract the thunderbolt. * * * Nay and more; he must not only consider that which is, but that which may be.—Robert Louis Stevenson.

Experimental Pavement in Queens Borough

Experience with cinders and asphaltic oil on dirt roads, with alternating rows of oak and stone blocks, and special bituminous macadam.

Pavements that depart material from local prevailing practice have been constructed during the past two or three years in the Borough of Queens, New York City. At the 1920 convention of the American Society for Municipal Improvements some of these pavements were described by E. E. Butterfield and Fred H. Shepheard, the former in charge of the laboratory of that borough. At the convention this year they presented a further progress report on these pavements, giving information which we present below in condensed form.

Cinders and Oil—One of the most satisfactory experimental pavements consisted of cinders and cold asphaltic oil applied to dirt roads. The borough has between 600 and 700 miles of dirt roads which must be kept open to traffic which is continually increasing in number and weight of vehicles. Many of these roads were formerly impassible in the winter and spring, but the treatment named has given them almost the stability of macadam and after a year's service they are still in excellent condition.

In this treatment the dirt road is honed and shaped with a Ford tractor and a Jumbo road machine and the cinders are spread by laborers with coal scoops. The cinders are then slightly compacted with a 10-ton roller and asphaltic oil is applied and the roadway then given a final and thorough rolling. In 1920, 7,000 tons of cinders were used in this way and so well withstood the winter of 1920-'21 that this season the borough has already used 23,000 tons of cinders on about 25 miles of roads. The cost in 1920 was 27 cents a square yard and in 1921 25.8 cents.

Key Block Pavement—On streets of heavy traffic, which had previously been paved with blocks of basalt, granite and sandstone, worn to a cobblestone surface, a pavement has been laid consisting of alternating rows of these old stone blocks and oak wedge blocks, the latter dovetailing the rounded sides of the stone blocks, with the top of the oak wedge projecting slightly above and overhanging the surface of the stone blocks.

In laying the pavement the old stone blocks

DIRT ROAD TREATED WITH CINDERS AND COLD ASPHALTIC OIL

are taken up, culled and laid in contact in rows transverse to the direction of traffic, the rows being separated by three or four-inch spaces which are filled with the oak wedges. These wedges are rammed in tight. On steep grades the wedges are allowed to project slightly above the stones, giving a corduroy effect; but in other cases they are rammed flush with the high points of the stones and covered with bituminous mastic, which gives the smoothness of a sheet asphalt pavement. Several blocks of this pavement were laid in June, 1919, on a 7 per cent grade which is subject to a large volume of heavy trucking, much of it horse-drawn. The key block pavement is a practical, non-slippery and anti-skid pavement causing much less noise than the one previously in use. So far there has been no maintenance cost.

(Many miles of this pavement, with the oak blocks driven flush with the stone blocks have been laid by the street railways of New York City in their track space.)

Broken Stone with Bituminous Treatment—"The underlying principle of old macadam construction was the waterbonding of the cementitious constituents of the stone. There was no reason for following this principle of cementitious value of stone after bituminous binders superseded the haphazard practice of waterbound macadam construction, but nevertheless the antiquated principle was blindly followed.

"In the borough of Queens we have built roads by the penetration method with different mineral aggregates, generally of the same nature as would be employed in concrete construction, and the results have been uniformly good, with the reservation that the harder minerals, such as andesite and basalt, tend to wear sharp and rough."

The borough has also laid a reinforced asphaltic concrete roadway, but too recently to report any results.

KEY BLOCK PAVEMENT ONE YEAR OLD

CRUSHED GRAVEL AGGREGATE

Using Old Asphaltic Material in Pavement Maintenance

Method employed in Milwaukee at 35 cents per square yard for plant cost and 30 cents for street cost.

C. J. Van Etta, superintendent of street construction and repair of Milwaukee, has for nine years been developing a method of using material removed from old asphalt pavements for making repairs, and feels that he has attained a success that encourages him to pass the information on to others. This he has done in a paper read before the Baltimore convention of the A. S. M. I., in which he stated that the old material has been used for repairs since 1912 with entire success as to both cost and wearing quality.

At the start he used a small hot mixer which could not produce more than 50 or 60 yards of 3-inch surface a day and the cost ran high because of this. However, after the first season he was so convinced of the value of the old material that he designed a machine able to produce about 25,000 square yards during the season of about six months. During the past five or six years he has so increased the capacity of the plant as to be able to produce something like a general average of 60,000 square yards of 3-inch surface in a season. The plant used is one built by Warren Bros. as a portable plant with the idea of drawing it about the city in making repairs, but it has been placed on a concrete foundation as a stationary plant and the reclaimed material repaired in it is hauled to the street by trucks. This was done because it seemed desirable to make some changes in the plant that would have been impossible with a portable mixer. With the plant as modified, the city is now producing from 300 to 700 square yards a day, the biggest day's run being 24 loads of 2½ cubic yards each, each load making about 30 square yards of surface.

The average daily cost of operating the plant, which includes common labor, engineer, firemen, foreman and truck drivers, fuel oil and other incidentals, is about 35 cents per square yard. The street cost, which includes the tearing up, trimming joints and other work necessary to prepare the street for the new material, and the hauling away of the old material, is about 30 cents per square yard. At the plant are used 22 common laborers at 65 cents an hour, an engineer at $1.05 an hour, a fireman at 80 cents per hour and truck drivers at $7.20 a day. There is also a team at $8 a day to be added to the force at the plant.

There is no set rule as to the amount of new asphaltic cement that is added to the old material, but this averages about 15 to 20 per cent. The men operating the plant have been on the work for eight or nine years and are so thoroughly experienced in handling the mixture that they can judge by the appearance of the old material about how much asphaltic cement should be added.

The wearing quality of the old re-heated mixture is remarkable. Mr. Van Etta cited two blocks of a street near the city hall that were resurfaced with this old material eight or nine years ago, just previous to the building of a bridge on the line of the main street which necessitated diverting the traffic onto this resurfaced pavement, 80 per cent of the main street traffic passing over this street. Up to date practically nothing has been spent in maintaining these two blocks.

When contracts are let for resurfacing an asphalt street they include a clause requiring the contractor to haul all of the old surface mixture, including the binder course, to the central plant and pile it at this point. This old material, including binder stone, is broken up with sledges as needed and put into the mixer to be heated to a point where it becomes workable. Breaking up by hand is expensive but up to date the city has been unable to find a crusher that would handle the material in warm weather. Last fall and early this spring a gyratory crusher was used for breaking up about 500 cubic yards and it was found that where it was crushed to material ½-inch diameter or less, much better results were obtained because of the short time required for softening and mixing the material. Using this crusher, only four men were required to break up the amount of material that required from 18 to 20 by hand labor at 65 cents an hour.

As soon as the weather became warm, however, the mixture became too soft for crushing. Mr. Van Etta expects to install, before next summer arrives, a crusher that will handle this material in warm weather, plans for which crusher are now under way. In connection with the new crusher it is proposed to have a belt conveyor that will carry the crushed material to a bucket conveyor which in time will raise the mixture to the hopper. At the present time it requires about 14 minutes to produce a batch of material where it is hand broken, but with the equipment now proposed it is estimated that a batch can be produced in about 8 minutes.

Debt Limit Prevents Sewage Plant Construction

The State Board of Health of New Jersey before the war ordered the town of Hackensack to erect a sewage disposal plant. Shortly thereafter the general confusion to all plans resulting from the war caused this matter to be held in abeyance, but two years ago the town was again instructed to begin work on such a plant in accordance with plans which had been adopted and accepted by the state board.

In reply to a recent notice from the state board asking why nothing had been done, Mayor Spencer D. Baldwin stated that the lowest bids received some time ago for carrying out the plans was $1,320,000, which was $400,000 in excess of the maximum amount to which state laws permitted the town to be bonded. He stated that the authorities intended to advertise for bids again early next year and, if those received were too high to permit construction of the entire plant, one unit would be completed in 1922 and the remainder the following year.

Quiet Pavements Near Schools

The Public School Principals' Association of Newark, N. J., has asked the city commission to adopt a paving construction program extending over, say, four years for providing noiseless pavements in the vicinity of schools, thus taking the lead among large cities of the country, which lead it was hoped and believed the other cities would follow. They stated that the constant noise at many of the schools caused by vehicles running over rough pavements prevented both teachers and pupils from carrying on their work most effectively and they believed that the greater efficiency permitted by the noiseless pavements would more than compensate for the additional cost.

A Concrete Laying Record

Another claim has been advanced for the record in laying concrete pavement, this time for the J. W. Etchison Construction Co., which is reported to have laid 863 feet of concrete pavement near Effingham, Ill., closing the gap in the Old National Trails road between Vandalia and the Indiana state line.

Recent Legal Decisions

CITY NOT LIABLE TO CONTRACTOR FOR FAILURE TO ASSESS WHERE CONTRACT VOID BECAUSE NOT LET TO LOWEST BIDDER

A street improvement contract provided, pursuant to the city charter, that payment for the improvement was to be from a special fund to be raised by assessment on the abutting property, and that the city should not be required to pay from any other fund, unless it failed to make a valid assessment. In an action by a contractor against the city to recover upon an alleged breach of the duty of the city to provide a fund to pay for the improvement, the Oregon Supreme Court holds, Montagu-O'Reilly Co. v. Town of Milwaukee, 199 Pac. 605, that the city was not liable for failure to make a valid assessment to pay for the improvement where the evidence showed that the contract itself was void ab initio, because it was not let to the lowest bidder as required by the charter.

CONTRACTOR ENTITLED TO ASSESSMENT ON COMPLETION WITHIN EXTENDED TIME, THOUGH CITY'S ACCEPTANCE DELAYED

The California Supreme Court holds, Federal Const. Co. v. Newhouse, 199 Pac. 519, that, in street improvement proceedings under the San Francisco street improvement ordinance, if the contract was actually completed within the time fixed in the contract by valid extensions, the assessment was not invalidated because it was not issued until after the time for completion had expired. If the contractor finished the work within the time required he was entitled to the assessment, even though the acceptance by the street commissioner was delayed.

DEBTS OF MUNICIPALITIES IN CALIFORNIA CANNOT BE GARNISHED THOUGH FOR PRIVATE ENTERPRISES, AS WATER WORKS CONSTRUCTION

The California Supreme Court holds, Irilarry v. City of San Diego, 199 Pac. 1041, that a debt due by a municipal corporation in the conduct of a private and proprietary enterprise, such as a municipal water system, may not be garnished in an action against the creditor. California is one of the states where the courts hold that municipal corporations are not subject to garnishment. The Legislature has provided in the Code of Civil Procedure a special method for the subjection of debts due from a municipality to the lien of a judgment.

CITY REJECTING CONTRACTOR'S TENDER OF PERFORMANCE CANNOT RECOVER ON HIS BOND

The Maryland Court of Appeals holds, Title Guaranty & Surety Co. v. Poe, 114 Atl. 481, that where one contractor agreed to take over a contract of another contractor with a municipality if he should be allowed to take over the original contractor's plant, and gave a bond for performance, but the city refused to accept his tender of performance, the surety on the bond was not liable either to the city or to the surety on the bond of the original contractor, which claimed that the second bond was for its benefit, since the second contractor's tender of performance and the city's refusal worked a discharge.

STREET IMPROVEMENT CONTRACTOR MAY RECOVER DAMAGES CAUSED BY NEGLIGENT MISTAKE IN ADVERTISEMENT AS TO AMOUNT OF EMBANKMENT REQUIRED

Where an advertisement for bids for a street improvement was inserted by virtue of the provisions of the charter prepared by the city's agents, it becomes the city's invitation to bid, and whatever representations it contains are the city's representations. When such an advertisement, by a mistake amounting to negligence, materially understated the amount of embankment which the contractor would be required to construct, it was the city's misrepresentation; and if the contractor had a right under the circumstances to rely upon it as being approximately correct, and, so relying, made a ruinous or unprofitable bid, the Oregon Supreme Court holds, Palmberg v. City of Astoria, 199 Pac. 630, that the city should be held liable, not on the ground of a contract, or on a quantum meruit for the reasonable value of the labor and expense of the contractor in bringing the embankment up to grade, but as damages for a negligent act inducing the contractor to enter into the contract and expend a greater sum in completing it than would have been necessary had the conditions been correctly stated. The error, however, must be due to carelessness, negligence or incompetency of the city's agent who made the mistake.

It was not necessary that the contractor should make new surveys or surveys from an independent profile on file, in order to verify the city surveyor's calculations, since he had the right to rely upon these computations as substantially correct.

It was also held that the contractor did not waive his right to recover by proceeding to complete his contract after discovery of the mistake, since a party induced by a false representation to enter into a contract may proceed to perform it and sue for damages for the misrepresentation.

PROVISION FOR PAYMENT OF DEBTS IN ROAD IMPROVEMENT BOND MAY EXCEED STATUTORY REQUIREMENT

The Oregon Supreme Court holds, Clatsop County ex rel. Hildebrand v. Feldschan, 199 Pac. 953, that a provision in a road improvement bond for payment of "all just debts, dues, and demands incurred in performance of the work" is valid and binding on the surety though the statute merely required the bond to be conditioned for the payment of labor and materials; and such a provision covers supplies furnished the contractor for the housing and maintenance of his men, etc., in rural districts. "Such provisions," the court said, "are in conformity to a moral duty resting upon county officials to see that its citizens and others who furnish laborers and subcontractors with materials and supplies, and extend credit to a contractor to assist in the performance of the public work, are protected. Such provisions tend to promote efficiency in the construction of the roads of a county. They are in the interest of justice and equity, and was not ultra vires."

NEWS OF THE SOCIETIES

Nov. 21—CHICAGO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Western Engineering Society.

Nov. 22—ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Nov. 22—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Adelphia Hotel.

Nov. 25—COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel, Denver. Secretary, William Lester, Vulcan Iron Works.

Nov. 28-29—KANSAS CITY SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Two-day regional meeting. Secretary, Louis Bendit, 517 Finance bldg.

Dec. 1-3—MONTANA IRRIGATION AND DRAINAGE INSTITUTE. Great Falls, Mont.

Dec. 5-8—AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS. Omaha, Neb. Secretary, J. H. Mullen, St. Paul, Minn.

Dec. 5-9—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual convention, New York City.

Dec. 6-9—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 14th annual meeting. Baltimore, Md.

Dec. 13—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary, N. L. Nussbaumer, 80 W. Genesee street, Buffalo.

Dec. 14—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' building, New York City.

Dec. 15—ENGINEERS' CLUB OF CINCINNATI. Cincinnati.

Dec. 22-23—KANSAS ENGINEERING SOCIETY. Annual meeting. Hutchinson, Kan. Secretary, J. M. Averill, Topeka, Kan.

Dec. . 27-31—AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, SMITHSONIAN INSTITUTE, Washington, D. C. Toronto, Canada.

Jan. 4-14 — CLEVELAND, OHIO, BUILDING EXPOSITION. Municipal auditorium, Cleveland, Ohio.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING. 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' building, New York City.

Feb. 21-23—MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention. Curtis Hotel, Minneapolis.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.,; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

WESTERN SOCIETY OF ENGINEERS

The November program of the Western Society of Engineers, included the following papers: "Illinia Harbor," by Col. W. V. Judson; "Layout and Design of the Modern Industrial Plant," by Frank D. Chase; "Engineering Features of Chicago's New Gas Plant," by J. I. Thompson. There will also be an "Experience Night," at which 15 minute talks will be given on personal engineering experience; and talks on "Business Management" and "Organization."

NEW YORK SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS JOINT MEETING

Regular meeting, November 14th. Subject: "The St. Lawrence Ship Canal and Power Project."

Speakers: Hon. Henry J. Allen, Governor of Kansas; Hon. W. J. Harding, former Governor of Iowa; Dr. R. S. MacElwee, Director of the School of Foreign Service, Georgetown University, Washington, D. C., on "The Greatest Single Step Along the Boston, Mass., on "The Power and Road to National Efficiency," illustrated by lantern slides; H. I. Harriman, of Transportation Features of the Project, Translated into the Economics of New England and the East."

BROOKLYN ENGINEERS' CLUB

At the Regular Meeting November 10th, Paper No. 177, entitled: "Oxy-Acetylene Welding from a practical standpoint," was presented by Mr. Nicholas M. Powell, of The Powell Welding Co., Brooklyn, N. Y.

At the informal meeting, November 17th, Industrial Brooklyn, Paper No. 6, on the processes involved in the production of Sugar, from the plantation to the commercial product familiarly known as "Domino Sugar" was presented by Mr. Richard Mommers, General Superintendent of the American Sugar Refining Company.

On December 1st, Industrial Brooklyn, Paper No. 7, the work of the Sperry Gyroscope Co. will be described by Mr. O. B. Whittaker, Supervisor of the Service and Installation Department.

NORTHWESTERN SECTION, A. S. C. E.

At a recent meeting of the Northwestern section of the American Society of Civil Engineers held in Minneapolis, Minn., the following officers were elected: President, W. T. Walker; first vice-president, George H. Herold; second vice-president, James B. Gilman; and secretary-treasurer, Paul C. Gauger.

OHIO CONFERENCE ON WATER FILTER PLANT OPERATION

The state department of health of Ohio has called a conference to be held at the Southern Hotel, Columbus, Ohio, November 2-22, at which it is expected that every water purification plant in the state will be represented. Mayors, directors of public service and superintendents of water works have been invited to attend the conference as guests.

INDUSTRIAL RELATIONS CONFERENCE

The Industrial Relations Conference was held at Harrisburg, Pa., on October 24-27th, under the auspices of the Department of Labor and Industry of Pennsylvania. The following subjects were discussed: "Industrial Co-operation"; "The Foreign Outlook"; "Women and Children in Industry"; "Stabilizing Industry and Employment"; "Industrial Waste"; "Industrial Education"; "Industrial Publicity"; "Medical Supervision in Industry"; "Workmen's Compensation." There was also an industrial welfare exhibit at the Penn Harris Hotel, at which materials were displayed relating to industrial efficiency, such as fire prevention and protection, safety devices, illumination, firestaid, health, hygiene, welfare, etc.

ENGINEERS' CLUB OF PHILADELPHIA

The Engineers' Club of Philadelphia, announces the following addresses at its luncheon meetings: November, "Accomplishments Under the Federal Water Power Act," by O. C. Merrill; and November 29, "The Kansas City Board of Public Welfare An Interesting Experiment in Civic Democracy," by Jacob Billikopf.

TEXAS SECTION, A. S. C. E.

The Texas section of the American Society of Civil Engineers at its annual meeting on October 28th elected the following officers: President, Col. E. B. Sands; second vice-president, Major W. J. Powell; and secretary-treasurer, E. N. Noyes.

ENGINEERS' CLUB OF TRENTON, N. J.

The Engineers' Club of Trenton, was addressed on October 2th by Thomas H. Wiggin on "Two Years' Experiences in China," illustrated with lantern slides; and on November 10th by Robert Fleming on "Building Codes," with particular reference to the proposed new building code for Trenton.

HOUSTON ENGINEERS' CLUB

The Houston, Tex., Engineers' Club at its meeting on October 18th was addressed by Thomas H. Ball on "The Houston Ship Channel and Its Future." The following officers have been elected: President E. G. Maclay, first vice-president, E. M. Wise; second vice-president, R. J. Cummins; third vice-president, W. H. Mead; and secretary-treasurer, A. J. Banta.

PERSONALS

Abney, G. R., of Beaumont, Tex., has been appointed highway engineer of Angelina county, Texas.

Martin, C. A., was recently appointed construction engineer on paving and sewage work for puyallup, Wash.

At the recent elections the following mayors were elected: Indianapolis, Ind., Samuel Lewis Shank; Louisville, Ky., Judge Huston Quin; Detroit, Mich., James Couzens, re-elected; Princeton, N. J., Dr. Charles E. Browne, re-elected; Albany, N. Y., William S. Hackett;Syracuse, N. Y., John H. Walrath; Yonkers, N. Y., Walter Taussig; Oneonta, N. Y., C. C. Miller; Elmira, N. Y., J. Morton Wood; Buffalo, N. Y., Frank X. Schwab; Rochester, N. Y., C. D. Van Zandt; Schenectady, N. Y., George R. Lunn, re-elected; Lackawanna, N. Y., Michael J. Mescall, the only Socialist elected in the state; Youngstown, Ohio, George L. Oles; Cleveland, Ohio, Fred Kohler; Cincinnati, Ohio, George Prescott Carrell; and Scranton, Pa., John Durkan.

Netleton, Edward S., acting city engineer of New Haven, Conn., has been appointed city engineer.

Wehrung, J. P., has been appointed district engineer for the Falls County Road District No. 5, with headquarters at Chilton, Tex.

Ward, Robert L. E., has been appointed city engineer of Canon City, Colo.

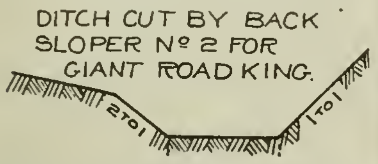
New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

BACK SLOPER ATTACHMENTS

Back sloper attachments to be connected to or removed from the Adams graders are designed to cut a clean, uniform back slope, a flat bottom and inside slope at one operation and are put on the market by J. D. Adams & Co. The attachment for the road No. 12 machine has been used for more than three years for successfully digging ditches to specifications on state and federal aid roads. It is hinged to the board and is made in two sections, one to cut the flat, bottoms and one to cut the back slope having renewable blades.

The back sloper attachment for road cleaning and giant road cleaning machines are practically alike. The section that cuts the flat bottom and inside slope is bolted on the inside of the blade and the back sloping section fits around the end of this special share and bolts to the board besides being rigidly supported by an arm bolted to the draw bar. The slopers can be attached to any road cleaning or giant road cleaning grader by quickly boring four holes in the mold boards.

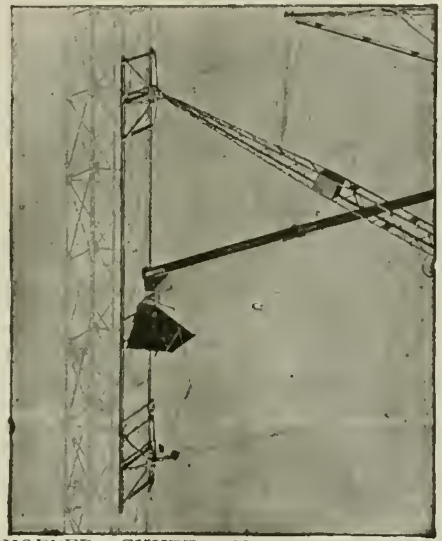


The side cutting of a back sloping attachment together with the load on the point of the blade tends strongly to pull the grader into the bank, and are offset with the Adams graders by leaning the front wheels.

The Adams scarifier grader No. 8-A is equipped with 3 leaning wheels and all adjustments of other Adams graders and possesses in addition a scarifier that may be used if desired instead of the 8-foot reversible regular blade. It is hauled by a tractor of required drawbar h. p., according to the working conditions. Most scarifiers and blades can be used separately or in combination, in the latter case loosening hard surfaces and removing it simultaneously.

IMPROVED SLIDING HOPPER FRAME FOR CONCRETE TOWER

The improved sliding frame on concrete towers manufactured by the Ransome Concrete Machinery Co., carries the rope bracket, boom bracket, straight backed receiving hopper and concrete chute, thus providing all required moveable connections and permitting them to be quickly shifted in a group to any required position between the top and the bottom of the tower to correspond to the different heights of hoists and to different lengths and elevations of spouting.



HOPPER, CHUTE AND BOOM, RANSOME SLIDING FRAME AND STEEL TOWER

The long light framework receives the reactions insures the correct relative spacing of different moveable units and is fitted to the corner members of the tower and distributes the stresses over them so as to avoid the possibility of concentrated loads and the buckling of the tower posts between the channel points of the tower bracing. It engages the flanges of the tower angles so as to maintain its alignment while it is hoisted or lowered, is quickly disconnected, shifted and reconnected so that little time is lost in its adjustment.

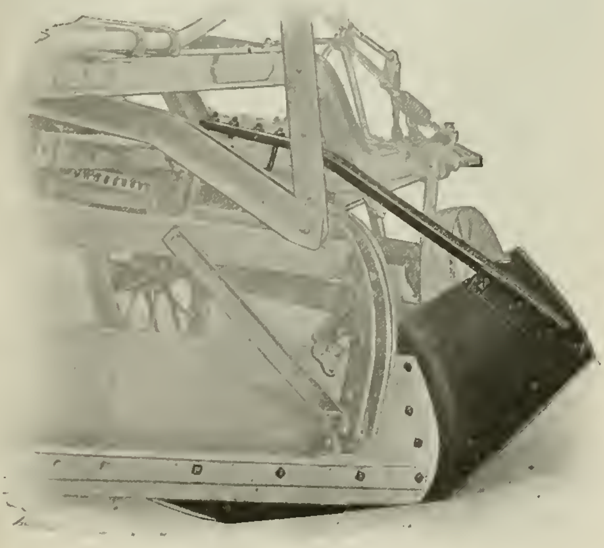
It can be operated with the boom shown in the engraving, or with the special improved boom made with two end sections of 5-inch pipe with steel connection castings at each end of the sections. These castings provide for the pin connections at the tower and for the tackles, and they also receive the middle section of the boom made with a pair of 7-inch channels 19 inches back to back, providing a clear space 7 feet long between them for the passage of the concrete chute. This boom is very rigid and simple in construction. The regular 48-foot length weighs 1,150 pounds, as compared with an equivalent latticed boom weighing 1,570 pounds. The strength is sufficient to permit the length to be extended if necessary by the use of longer pieces of pipe for either of the end sections.

CHAMPION SNOW PLOW

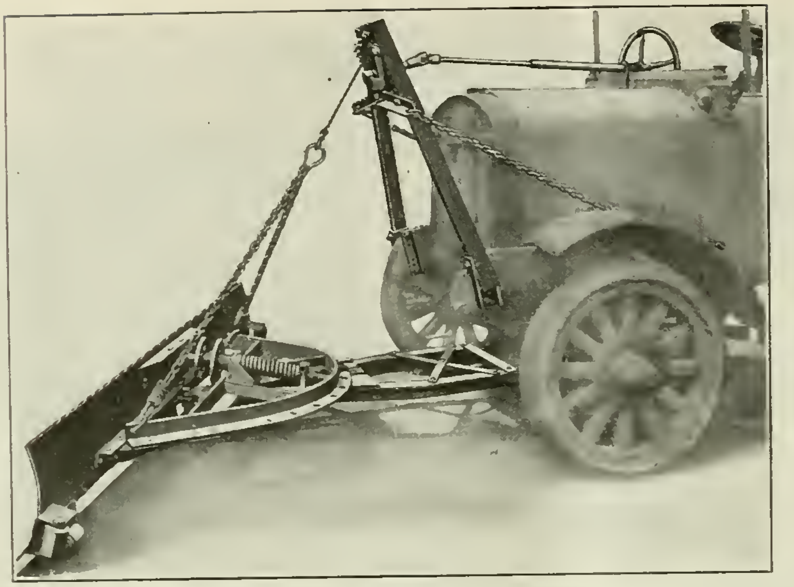
The Champion Snow Plow manufactured by the Good Roads Machinery Co., Inc., has been designed to meet the demand for rapidly and conveniently cleaning city streets and country roads from snow and ice during and after snow storms. Installed on a motor truck it is able to move with the traffic and ahead of the traffic, and clear the street without blocking it. It has been developed during the last 5 years and can now be attached to any truck or tractor quickly.

It consists essentially of a steel scraper blade 10 feet long and 16 inches wide, hung to a semi-circular steel frame, providing angular adjustments

GRADER IN INCLINED POSITION MAINTAINED AT CORRECT ANGLE TO CUT ACCURATE SLOPES BY LEANING WHEELS



BACK SLOPER ATTACHMENT FOR ROAD KING AND GIANT ROAD KING



ADJUSTABLE SNOW PLOW INSTALLED ON MOTOR TRUCK

and making it possible to set the scraper blade at any desired angle for right or left hand cutting. The angle is changed and fixed by setting a pin in the semicircle.

The principal advantages of the Champion plow include the automatic blade connection that permits the blade to pass over obstructions and immediately return to operating position; the universal axle clamp built to be attached to any truck having I-beam or rectangular section of front axle; the universal lifting device consisting of a hand wheel and worm gear that can be easily and quickly attached to any make of truck; the tilting device that moves the scraper blade backward and forward with a wheel or screw mechanism to suit any condition of snow removal and the 5 x 16-inch mold board 10 feet long and 4 feet wide with a 6 x ¼-inch carbon steel edge 10 feet long that can be renewed.

Large numbers of the Champion Snow Plow have been used by the Street Highway Departments of Pennsylvania, 500 are in use for the street cleaning in New York and many are used in other states and cities The catalog illustrates them in service attached to various makes of trucks, tractors and steel mules and to a motor chassis.

INDUSTRIAL NOTES

The Bucyrus Co. announces the removal of its New York office to 30 Church Street, with E. G. Lewis as Eastern sales manager, effective December 1st. M. J. Woodhull has been appointed general sales manager to succeed Mr. Lewis in Chicago, and E. R. Weber, Northern sales manager at Minneapolis to succeed J. N. Gawthrop,who will become associated with Mr. Lewis in New York.

The waterworks at Hopewell, Va., have been sold by the Du Pont Chemical Co. to the Industrial Service Corporation of Virginia, which corporation took over the operation of the plant November 1st, with J. F. Muhlig as general manager and operating head of the new corporation.

The Austin Machinery Corporation announces that the Canadian Austin Machinery, Limited, Woodstock, Ontario, incorporated under the laws of Canada, will henceforth act as sole manufacturers and distributors in Canada of the complete Austin line of earth-moving and concrete-mixing equipment.

The Consolidated Expanded Metal Companies, Braddock, Pa., announce the opening of a direct branch office and eastern distributing warehouse at 537 West 35th St., New York City. The new sales office will be under the personal direction of Thomas R. Herbest, Jr., who during the past seven years has established and operated similar distributing stations for this Company in Philadelphia and Pittsburgh.

The Bucyrus Company announces the removal of its New York office to suite 728, 30 Church Street, with E. G. Lewis in charge as eastern sales manager, effective December 1. M. J. Woodhull is appointed central sales manager to succeed Mr Lewis in charge of the Chicago office. 622 McCormick Building.

E. R. Weber is appointed Northern Sales Manager, at Minneapolis, 1224 McKnight Building to succeed J. N. Gawthrop, who will become associated with Mr. Lewis in New York.

Ben. L. Whitney formerly with the Byers Co. has opened an office at 528 Detroit Savings Bank Bldg. Detroit, Michigan, and will represent the Orton & Steinbrenner Co. in that territory.

The Perfection Hoist & Engine Co., formerly of Milwaukee, Wis., has opened up a new factory at Two Rivers, Wis., for the manufacture of its "Perfect horizontal mechanical hoist" and the "Perfectlite" isolated light and power plants for farm homes.

The Universal Crane Co., Elyria, Ohio, has appointed George L. Sawyer to represent it in the New York field in the sale of Universal cranes, with office at 141 Center street, New York City.

EXHIBITS AT THE A. S. M. I.

In connection with the convention of the American Society of Municipal Improvements held in Baltimore October 25th to 28th, a number of firms dealing in materials used by municipalities in public work exhibited samples and literature of their materials in neatly constructed booths in the convention room and the hallway leading to it. The idea of having booths in the convention hall was not a happy one, as it was necessary either for the exhibitors to entirely forego the use of their booths for discussing their products with interested parties, or to interfere with the meetings of the convention by holding such discussions. It is greatly to the credit of the exhibitors that they absolutely adhered to the former, much to their own disadvantage. Certainly if they are consulted no future conventions of this or other societies at which exhibits are presented will try to combine the exhibit and convention hall.

Those who rented booths at this convention were the following: Granite Paving Block Manufacturers Association, Public Works, Wayne Iron Works, Holt Manufacturing Co., Elgin Sales Corp. Manufacturers' Record, Asphalt Association, Engineering News-Record, Engineering and Contracting, American City, Fidelity and Deposit Co., John C. Louis, National Paving Brick Manufacturers' Association and Eastern P. B. M. A., Hastings Pavement Co., Standard Oil Co. of New Jersey, Dorr Co., National Steel Fabric Co., Barrett Co., Lock Joint Pipe Co., Koehring Machine Co., Dunn Wire Cut Lug Brick, Warren Bros. Co., Core Joint Concrete Pipe Co., Portland Cement Association, Austin-Western Road Machinery Co., Henry H. Meyer Co., Pioneer Asphalt Co., Celite Products Co., Texas Co., W. & L. E. Greeley, The White Co., East Iron & Machine Co., Asphalt Refining Co., International Motor Co., Peerless Weighing Machine Co., Modern City.

NEW CALCULATING MACHINES

The Monroe Calculating Machine Company has just brought out a new model calculating machine to be made in three sizes, 12 to 20 place capacity. Special features of these machines include light keyboard touch and easy crank turn; one stop operating crank; removable operating crank; dial clearout; repeat and non-repeat keys, speed with accuracy and visible proof.

THE UNITED STATES CAST IRON PIPE AND FOUNDRY COMPANY

The United States Cast Iron Pipe and Foundry Company, Burlington, N. J., has opened a new office at 811 Dixie Terminal Building, Cincinnati. P. T. Laws, Assistant Works Manager, will make this point his headquarters. Sales from this office will be in charge of Mr. Harold G. Henderson.

ZONING IN NEW HAVEN

It has been announced that Mayor Fitzgerald of New Haven, will promptly put into force int that city a new zoning law, passed by the last Connecticut Legislature to give aldermen power to regulate the operation in various parts of the city.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

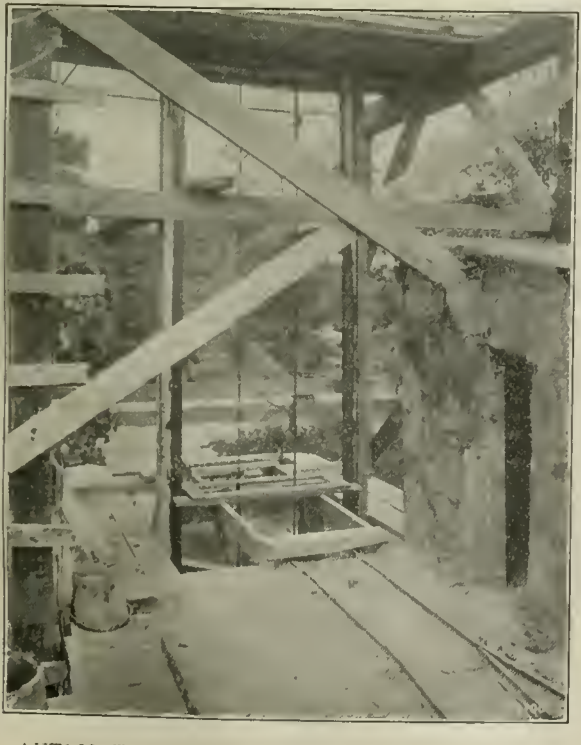
Vol. 51 NOVEMBER 26, 1921 No. 22

Linwood Avenue Tunnel, Milwaukee Water Works

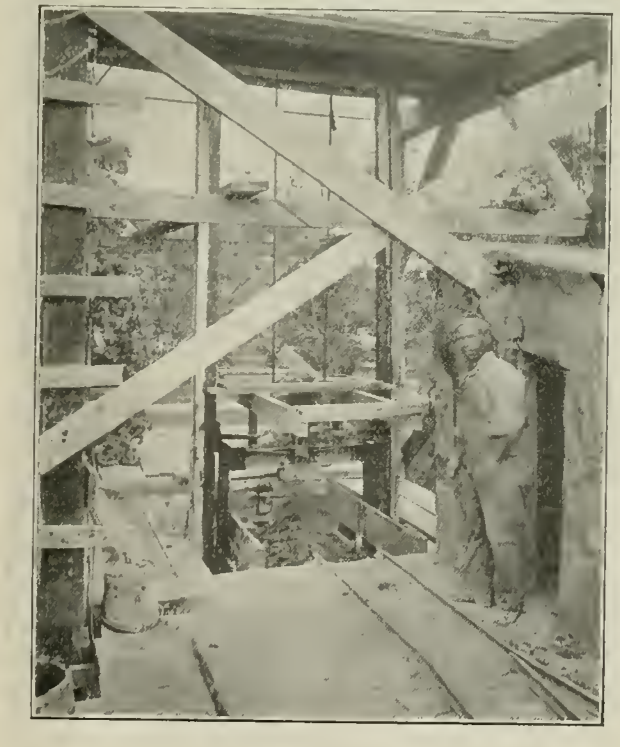
Waterworks tunnel 7,464 feet long and 9 feet in diameter, driven from two shafts alternately, through clay, under 27 pounds pressure, without shield. Shaft linings partly sunk and partly underpinned. Hard clay excavated with pneumatic tools.

A supplementary water supply for the city of Milwaukee is to be drawn from Lake Michigan through an intake crib located in water 67 feet deep and 6,500 feet from the shore line and through a tunnel, one section of which, now under construction, extends from a shore shaft 7,085 feet across the Lake Park and under the center line of Linwood avenue, in the fine residential part of the city, through the Lake Drive and Oakland Construction shafts and under the Chicago and Northwestern Railway, the Milwaukee river and a 5-foot intersecting sewer to a gate well outside the location for the proposed Riverside pumping station.

This section of the tunnel is on a tangent and is uniformly graded down from the lake and to the gate well, descending 12 feet in 7,000 feet. The nine test borings made on the center line in advance of the construction work indicated that the tunnel would



AUTOMATIC SAFETY BARRIER IN POSITION PROTECTING OPEN SHAFT



ASCENDING CAGE AUTOMATICALLY RAISES SAFETY BARRIER pass from the lake to the pumping station through gray and sandy clay with boulders, hardpan, sandy hardpan, and blue clay, and the materials that had been encountered on November 1st when the excavation was 99.3 percent completed was characterized as chiefly "hard stony clay with pockets and strata of water bearing sand, quicksand and gravel in wavy strata, substantially horizontal. The clay was found to be frequently stratified with alternating seams ½ inch to 3 inches thick, filled with water-bearing sand and having occasional pockets of sand and gravel, but no pockets of harmful gases, which are sometimes found in clay strata."

EXCAVATING SHAFTS

Besides an 11 x 11-foot and a 5 x 7-foot gate well, there are two permanent construction shafts 10 feet in diameter inside, one of them at Lake Drive, 1,341 feet from the lake end of the tunnel, from which headings have been driven in both directions to a combined length of 3,475 feet, and the other at Oakland avenue about 1,550 feet from the proposed pumping station, from which headings will have been driven in both directions to a combined length of about 3,989 feet.

Both shafts were excavated square, braced by 10- x 10-inch timber sets spaced 4 feet center to center, with 2-inch maple sheathing at the outside of the excavation. The cross-section of the excavawas 18 x 18 feet, offset at a depth of 16 feet to a cross section of 16 x 16 feet. The Oakland avenue shaft was excavated by this method to a depth of 33 feet and the Lake Drive shaft to a depth of 58 feet. At these depths, concrete caissons were built 10 feet inside diameter with a 12-inch shell in 12-foot sections to a height of 36 feet.

At the bottom of each caisson a steel cutting edge was placed, made up of a 6- x 6-inch angle iron to which was rivited a 7/16-inch steel plate fixed to the outside of the concrete shell to a height of 6 feet. The earth excavated inside the concrete lining with air hammers allowing the caisson to sink by its own weight. The Oakland avenue shaft was sunk through 14 feet of red clay, 7 feet of blue clay, 15 feet of sandy gray clay, 54 feet of hard stony gray clay and 10 feet of sand and gravel to a total depth of 100 feet below the surface of the ground or 30 feet below the water level, corresponding with the surface of the lake.

The spoil was excavated by hand, using bars, picks and shovels and the hard clay was loosened and detached without explosives, by Ingersoll-Rand pneumatic "coalpicks" with 8-inch octagon bits about 1 inch in diameter. The work was done with three 4-man shifts per day, each working 8 hours and making a progress of about 3 feet in 24 hours. They removed the bottom in lifts of 4 to 6 feet and maintaining a sump 3 feet deep, from which the water was readily drained by a Nye pump.

UNDERPINNING SHAFT LINING

When the shaft entered the gravel stratum, about 63 feet below the ground, the sinking of the concrete lining was stopped by the increasing friction on the exterior surface, and the excavation was continued 10 feet to the underlying hardpan inside with four successive courses of 2 x 6-inch sheeting boards about 30 inches long with their abutting ends bearing on a 4- x 1-inch inside sectional flange bolted steel ring. The sheeting was placed in successive annular trenches dug around the circumference of the shaft in 30-inch lifts that were sheeted as fast as circumferentially extended. The first course of sheeting took bearing at the upper end on the cutting edge of the concrete lining and at the lower end on the steel ring, which also received the top of the next course. Vertical anchor rods were imbedded in the bottom of the 40-foot upper section of the concrete lining, with rings turned on their lower end and projecting below the cutting edge, thus forming connections for hooked vertical rods, with rings on their lower ends, which were built into the concrete lining that was placed against the sheeting boards in 5-foot courses that, after setting were suspended from the fixed lining above while excavation was continued below their lower edges.

After the annular trenches were excavated and sheeted, the core in the center of the shaft was removed, another lift was taken out of the bottom, and so on until the excavation was carried through the gravel to the hardpan, where it was continued and the construction of the successive 6-foot underpinning rings of the lining was carried on the same as the above described, except that the vertical sheeting, being unnecessary because the hardpan would stand without sliding, was omitted. The Lake Drive shaft was 120 feet deep and was excavated and lined in the same manner as the Oakland avenue shaft, except that in this case no sheeting was required, and the lining was built by the suspended courses 6 feet high for the lower 80 feet of the shaft. The Lake Drive shaft was driven through 58 feet of stiff red clay, 12 feet of sandy red clay, 10 feet of stony blue clay and 40 feet of hard stony red clay.

The Lake Shore gate well, 44 feet deep, was excavated through red clay for its entire depth; both of the gate wells were excavated and lined in the same manner as the Lake Drive shaft.

TUNNELING PLANT.

Tunneling operations were commenced from the Oakland avenue shaft, where, at the surface of the ground, a shaft house and power plant were installed and were equipped with four Ingersoll-Rand air compressors of the Imperial type, having capacities of 1,000 feet, and 1,200 feet of free air per minute compressed to a pressure of from 12 to 31 pounds and of 850 cubic feet per minute compressed to 100 pounds or more, all of them driven by electric motors. The shaft elevator cage was operated by a Thomas electric hoist and there were two Jeansville centrifugal pumps of 6-inch and 5-inch diameter and two steam driven Cameron plunger pumps, one of them used for grouting.

The concrete for the tunnel lining was mixed in a Koehring ½-yard machine, installed 10 feet below the surface of the ground so as to be fed by gravity from the aggregate and cement storage on the surface, and discharging through a chute to the ½-yard side dump cars in the tunnel which were operated on a 14-inch guage track and handled both concrete and muck.

TUNNEL EXCAVATION.

The tunnel was excavated with a full width top heading having a semi-circular cross section, 11½ feet in diameter. The clay was split off in chunks after having been drilled with three Kellar and small Ingersoll-Rand pneumatic "coal picks" making inclined holes close together and operated by three miners in each 8-hour shift. As fast as the extrados of the heading was excavated down to a level 1 foot below the spring line of the arch, the roof and sides were supported with continuous arch timbering consisting of bents made with five arch segments, each composed of two 3- x 6-inch planks, fastened together with cleats on the inner surface at each end. These were set up on 4- x 6-inch longitudinal bottom sills and when necessary were tightly adjusted in position by wooden wedges driven home between the cleats at the ends of the segments. A permanent lining 3 inches thick was thus formed outside of the concrete work and protected the miners from roof falls, which, however, seldom threatened.

On a few occasions where the ground was very bad, a small amount of gravel up to 1 or 2 yards fell from the roof, but loose places were generally supported by the timbering in time to prevent any fall. When sand and gravel pockets were encountered, the surface was packed with hay that served as a strainer, holding back the solid matter and permitting the water to seep freely through to the tunnel, where it was collected in the drains to the sumps.

As fast as the spoil was excavated it was shovelled by three muckers into the dump cars which were drawn to the foot of the shaft by two mules. The cars were run on a single-track service line, laid on the platform that floored the finished tunnel lining 18 inches above the lowest part of the invert. Besides the muckers and miners there were two skinners, one lock tender and one foreman, making a total force of ten men in each of the three 8-hour shifts daily.

The dump cars were hauled to the air locks at the foot of the shaft and there hoisted on the platform of the elevator cage, and transferred to a surface track running to the spoil bank. In order to prevent the possibility of cars on the spoil track being accidently pushed into the shaft when the cage was below the surface, the top of the shaft was protected by a moveable horizontal framework supported on the surface of the ground alongside the shaft, and having longitudinal timbers connected by transverse pieces providing a stop for the cars on the surface track. A pair of transverse timbers across the top of the longitudinal pieces at the center point served as guides engaging the vertical timbers of the framing and had clearance between them that permitted the hoisting ropes to operate but would not clear the sheave on the top of the cage over which the hoist rope passed; therefore the framework formed an automatic safety device that, when the cage was lowered, rested on the surface of the ground. When the cage rose to ground level, the sheave frame engaged the transverse guide strips and carried the framework to the top of the hoist while the top of the shaft was closed by the cage and the cars were rolled on or off the platform. The descending cage deposited the safety framework in position on the ground as soon as the cage itself ceased to protect the shaft.

The heading was excavated at the rate of from 8 to 12 linear feet daily according to the condition of the ground encountered; and the bench or "box," in sections up to a maximum of about 15 feet long, was excavated in the same manner as the face of the heading except that the holes drilled in it were in substantially vertically planes. The total amount of excavation averaged about two yards per linear foot of tunnel. The concrete in the lining averaged about one yard per linear foot and the work was executed by the contractor, H. Hohensee, at an average rate of about 6 linear feet daily in each heading. The unit price was $66.97 per linear foot of completed tunnel.

CONCRETING

The excavation for the invert was cut carefully and smoothly to coincide with the required exterior surface of the cylindrical lining up to one foot below the spring line. Pyramidal concrete blocks about 12 inches high and 6 inches thick at the top were set about 4 feet apart on the center line of the tunnel floor and intermediately supported the 2- x 6-inch lagging strips 12 feet long that were carried at the rear end on the finished concrete invert and at the forward end on a wooden transverse profile board forming a bulkhead to retain the concrete. The center strip of the invert concrete about 2 feet wide was then laid between the finished invert and the bulkhead, enclosing the pyramidal blocks. Immediately following this there were set on it vertical transverse circular ribs of 3- x 3-inch angle iron made in halves spliced with fish plates, at the spring line, and spaced 4 feet apart on centers. These ribs were braced together by four approximately equidistant lines of wooden longitudinal struts bolted to them.

The 2- x 6-inch wooden lagging strips were placed from the bottom up, symmetrically on both sides of the center as fast as the concrete was filled in over the upper bar on each side, and thoroughly tamped and rolled to position. As soon as the concrete was brought up to the spring line, horizontal cross pieces were bolted to the ribs to support the floor, which was laid through the forms, carrying the service tracks on which the concrete was delivered. The concrete was shoveled by hand over the side wall and arch lagging bolted to the outer flanges of the ribs, until the lining was completed up to the crown, where a space about 10 inches wide on each side of the center line was left by the omission of the lagging and was covered by curved 24- x 24-inch plates, 1/8 inch thick, supporting the dry concrete in the key of the arch which was thoroughly rammed to position, thus finishing the arch. The concreting operations were conducted alternately with the mining and mucking, as the concreting interfered with the operation of the mucking cars.

TESTING FOR GAS

Precautions were taken to detect the presence of gas that may escape from pockets and fissures in the clay and collect in the tunnel. As this gas is colorless and tasteless, its presence is not obvious and if it occurred would be dangerous on account of its explosive character when mixed with certain proportions of atmospheric air conditions that have caused fatal explosions in other tunnels, notably in the Cleveland waterworks tunnel, driven through a clay stratum.

Samples of tunnel air are collected daily in one-gallon bottles, brought into the tunnels filled with water, and emptied near the tunnel invert at the headings, where they become immediately filled with air or any gas that may prevail there and are hermetically sealed. They are carried to the laboratory and their contents are immediately tested by the Orsat method, which consists in passing the sample air first through potash to remove the carbon dioxide, after which it is carefully measured for volume and passed through phosphorus to burn out the oxygen; measuring it again shows whether there had been too little oxygen and if this is the case it follows that the deficiency in oxygen must have been made up by some other gas which is determined by a second analysis, eventually showing whether the air contains any dangerous amounts of injurious gas. So far this has not been the case and the 20.1 to 20.5 percent of oxygen that it contains indicates the presence of not more than 5/10 of one percent of carbon dioxide, the dangerous element that is sought for.

GROUTING

In order to fill the cavities that may exist around the sheeting or close to the tunnel in the stratum through which the excavation is made, the exterior of the concrete lining is thoroughly grouted with neat cement grout to the amount of about 1½ barrels of cement per linear foot of the tunnel. As it has been found by experiments and observation that grout travels from 300 to 400 feet along to the exterior surface of the lining, the grout is ejected at 110 pounds pressure through 2½ inch pipes about 100 or 200 feet apart in the crown of the tunnel, thus requiring the grout to travel not more than ¼ of the possible distance in order to reach the full length of the tunnel construction.

This distribution of the grout is believed to be limited to a maximum width of 10 or 15 feet each side of the tunnel center where the original strata has been disturbed and thus involves little loss of grout by its penetration to places where it is not needed, remote from the tunnel alignment. The grouting operations are carried out only at intervals of several weeks according to the progress that has been made in the tunnel construction. The amount of grout ejected through the grout holes is governed entirely by the capacity of the pump, which is operated until it stops through resistance equalling its pressure.

A very smooth and uniform finish is given to the interior of the tunnel by a 1/16-inch coat of plaster made of one part cement and two parts sand, and applied with a trowel within 24 hours after the forms are stripped.

AIR LOCK

The pneumatic pressure is maintained in the tunnel by means of an air lock 21 feet long, (capacity of 3 cars) located near the foot of the shaft and formed by two vertical transverse 16-sided steel plate diaphragms ½ inch thick projecting half way through the 12-inch thickness of the concrete lining. Each diaphragm has a 5- x 5-foot concentric retangular opening with the horizontal lower edge 18 inches above the center of the invert. The edges of the opening are reinforced by angles and plates and the opening itself is closed by a ½-inch thick steel plate door reinforced around all the edges by a 3-inch riveted strip planed to one inch in thickness and grooved to receive the rubber gasket. The door is provided in the upper part with a 6-inch bulls eye, and is reinforced by three 6-inch horizontal I-beams at approximately equidistant spacing. The gasket ½ inch thick and 2 inches wide is T-shaped in cross section with the stem dovetailed into groove. The door hinges have cylindrical pins in slotted holes allowing abundant play to insure the door to be pressed firmly against the gaskets by the air pressure. The total weight of one bulkhead and door is about 2,900 pounds.

Most of the gravel was located in the roof of the excavation and extended down in the face as low as the spring line of the tunnel. When mining through this, the compressed air passed out very freely and cropped out at the surface as far as 1,000 feet from the heading. In order to confine the air to dry up the ground, plastic clay was spread over the unlined section. Grouting outside of the concrete lining, as previously described, and mudding up, cut down the loss of compressed air and made it possible to keep the tunnel dry with the number of air compressors used.

The ground in Milwaukee is very irregular and in an advance of 10 feet of a tunnel, there may be a complete change of stratification. Due to this condition, the Linwood avenue tunnel was driven under air pressure, thereby making condition of operations safer and assuring a tunnel built in the dry.

The work was designed and executed by the City of Milwaukee, George F. Staal, city engineer and Arthur H. Raelzman, resident engineer.

Funds for Municipal Work

Information was sent out under date of November 8th by the President's Conference on Unemployment giving some figures obtained from the 13 states of Illinois, Connecticut, New Hampshire, Michigan, Wisconsin, Ohio, Rhode Island, Pennsylvania, New York, Minnesota, New Jersey, Massachusetts and Indiana. In these states more than $60,000,000 in city bonds have been sold recently and $34,000,000 in addition have been offered for sale.

The largest state bond sale was that of $5,000,000 for highways in Illinois, while Michigan had sold for highways $3,000,000 of a $4,000,000 offering. The rate of the state bonds was 4 percent for Illinois, 5 percent for Connecticut, 5.5 percent for the soldiers' bonus of Michigan, and 5.75 percent for Michigan highway bonds. The city bonds ranged from 4 percent in Chicago to 7 percent in Hibbing, Minn., but the majority were 6 percent bonds. The greater part of these bonds were for erecting or extending highways, schools, sewers, filtration plants, water works, hospitals, parks, forest preserves, bridges, lights, paving, court houses, fire department and police department equipment, streets, sidewalks, beach improvements and memorial playgrounds.

Col. Arthur Woods is quoted as saying: "All of this work will undoubtedly go forward within a few months. If, by any encouragement we can give, any of this work can be put under contract even a few days earlier than otherwise, the unemployment period will have been diminished to that extent and to that degree."

As to federal appropriations, in addition to the federal aid road bill, the Smith bill is being speeded up by the house committee for the irrigation of arid lands, this bill appropriating $20,000,000 for the immediate prosecution of reclamation projects already begun.

Indianapolis Water Company Completes Reservoir

On Tuesday, November 15th, the Indianapolis Water Co. entertained a number of representative citizens of that city at its Riverside pumping station in order to give them an opportunity to inspect the 10,000,000-gallon clear-water reservoir which is practically completed and also the pumping station property. This reservoir is 564 feet 6 inches long and 258 feet wide, with a concrete roof covering an area of 3¼ acres. The depth of the reservoir from the low point in the floor to the roof is 10 feet 8½ inches. In its construction there were involved 52,175 cubic yards of excavation, 25,000 cubic yards of embankment, 11,160 cubic yards of concrete, 468 tons of steel reinforcing bars and 60,000 brick for the baffle walls.

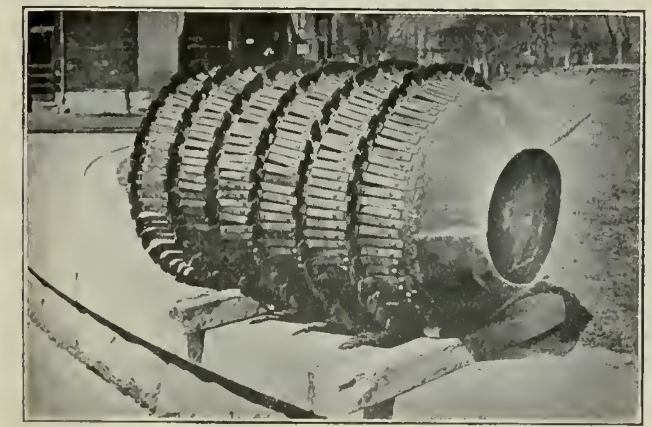
Cleaning St. Louis Water Mains

New machines designed for cleaning 30-inch and 36-inch mains, and experience with experimental machines

An ordinance passed in the city of St. Louis in 1920 provided for cleaning 250,000 feet of water main and a contract was let that year to the National Water Main Cleaning Co., the only bidders, for cleaning 12 and 20-inch mains at 28 cents a foot and 30 and 36 inch mains at 35 cents a foot.

The cleaning of the larger mains was considered to be something of an experiment. All but one of the large cleaning machines so far designed had been of the "pontoon" type. The central air chamber, which also serves as a rigid axis for the cutter heads, gives the machine enough buoyancy when in the water to prevent the over-cleaning of the pipe bottom to the deteriment of the top of the pipe. A 30-inch machine of a different type was designed and tried but found to be basically defective. A 35-inch machine of improved design was used which had five heads each containing 80 blades. The first and last sections were welded to the pontoon, while the middle three were hung loose and held in place by chains, the theory being that the machine would round corners more readily with loose sections than if all the heads were attached rigidly to the air chamber. These loose heads proved to be not only unnecessary, since the greatest degree of curviture in commonly used 36-inch castings is 15 degrees or a 1/24th bend, but in work on Grand Avenue they were positively detrimental. The Grand Avenue 36-inch low pressure main had been in continuous service for 50 years. The machine was inserted with the intention of cleaning the entire 18,446 feet at one shot. When the water was turned on behind the machine it progressed satisfactorily at a speed of about 85 feet per minute until the first 36 x 36 three-way was encountered. At this point the front head got into the three-way opening and the machine swerved off line sufficiently to jam, since it was held to its course by the rear head only. After several days' work spent in removing the dome from a nearby valve, the main was entered, the head lined up, and pulled past the three-way opening with jacks, and the shot completed. The rest of this line was cleaned without difficulty, but following this the machine was scrapped and last winter was spent in designing a new cleaning machine.

Late in March of 1921 a new 36-inch machine was delivered and put into use. This new cleaner contains six heads of 80 blades each, the first three being sawtooth and the rear three plain scrapers, all rigidly attached to the central air chamber. The free diameter of all the heads is 38 inches from tip to tip of blades. The volume of this air chamber was made smaller than in the other scrapers to avoid cleaning the top of the pipe more thoroughly than the bottom, which had been the effect of the other scraper on three blocks of Grand Avenue personally inspected by Leland Chivvis, engineer in charge of the distribution section.


SECOND 36-INCH CLEANING MACHINE

The new machine did good service, a test made on the section cleaned showing that the capacity of the main had increased to 98 percent of that of a new main, although before cleaning its capacity had been only 67 percent.

Highway Building in New Jersey

The state of New Jersey's highway commission has pledged for road work, mostly in the form of aid to counties, all of its revenue of 1922, which it expects to obtain, under the Edge Road Tax Act, and road building may end with the completion of the present contracts unless some plan of financing is devised Governor Edwards has recently suggested to the highway commission that the several counties be asked to go ahead with the construction of those sections of the state highway system which lie within their respective boundaries, with the understanding that the state will reimburse them in the years 1924 to 1926 from the funds which are expected to be then available.

With a view to carrying out this suggestion, the highway commission is to hold meetings during November in different parts of the state to discuss the proposition with the counties, the counties being divided into geographical groups for discussion of the matter with the commission.

Refuse Disposal in Chicago

Garbage collection and delivery cost $7 a ton. The reduction plant was operated last year by the city at a loss of nearly half a million dollars.

The report of the Department of Public Works of Chicago for the year 1920, which has just been received, gives the following information concerning municipal garbage collection and disposal in that city.

Of garbage, as distinguished from ashes and rubbish, there were collected 78,701 tons by the Bureau of Streets and 1,692 tons by private scavengers. All of the municipal collection and 1,123 tons of the private collection were delivered at loading stations, from which they were taken by boat to the municipal reduction plant, except for a comparatively small amount taken to the plant by direct haul by teams. The collection and delivery of the garbage cost the city $551,332 for the year, or $7 per ton, or 20 cents per capita.

The total amount of garbage received at the reduction plant, 80,132 tons, was 2,684 tons less than in 1919. From this garbage there was produced by reduction 2,208,620 pounds of garbage grease and 11,415 tons of garbage tankage. Of the garbage grease, 1,660,620 pounds were sold at an average price of 5.14 cents per pound, or a total of $95,310. The amount of garbage tankage produced was 11,415.4 tons, of which 11,170.4 tons was sold for $81,421. In addition to these, the animal grease, rags, bones and hides from the garbage and miscellaneous scrap were sold for a total of $14,016.

In addition to this total of $190,747 received from sales, the inventory at the end of the year showed an increase over that at the beginning of $50,726, giving a net revenue for the year of $241,474. The operation expense of the plant was $695,248. This shows a net loss in operation of the plant of $453,774. This large loss was attributed to an increase in the cost of labor and supplies and a decline in price received for the products of reduction. The cost is probably greater than in most cities, and certainly than in most privately operated reduction plants, because the Chicago plant is operated in as sanitary a manner as possible. "No complaints have been registered during the year by residents or enterprises in the locality as to offensive odors. The many visitors during the summer months, when garbage is most offensive and when the plant is taxed to its capacity, have been unanimous in expressing surprise at the inoffensive manner in which the garbage is handled and the absence of obnoxious odors."

During the year $41,102 was spent for construction and rehabilitation work at the plant, of which about 65 percent was paid from the waste disposal building and equipment bond fund, and most of the remainder from the corporate fund.

The cost of operation per ton of raw garbage is itemized as follows: salaries and wages, $5.099; fuel oil, $1.452; power and light, $0.165; coal, $0.061; supplies and repairs, $1,359; total, $8.676. The similar items for 1919 were approximately the same except for coal, which was $0.455, fuel oil which was $0.805, and salaries and wages which total $3.819; giving a total cost for 1919 of $6.625.

The prices received for garbage grease varied from 5.5 cents to 6 cents per pound, animal grease from 5.25 cents to 7 cents, hides 26.23 cents, garbage tankage from $7 to $12 per ton, garbage bones from $20 to $22, and garbage rags and scrap metal $9 per ton.

The monthly receipts of garbage varied from a minimum of 4,412 in February to a maximum of 10,438 in September. In 1919 the minimum had been in December, with 4,436 tons, and the maximum in August with 9,820 tons. The monthly production of garbage grease varied from a minimum of 62,500 pounds in October to a maximum of 288,520 pounds in May. The difference in the quality of the May garbage and the October garbage is indicated by these figures, which show the garbage grease produced per ton of garbage in May to have been 57 pounds per ton while in October it was 6.3 pounds per ton; the average for the year having been 27.6 pounds. Of tankage, the May garbage produced 0.21 ton, the October garbage 0.084 ton, while the average for the year was 0.142 ton.

Street Cleaning in Chicago

During the year 1920 the Department of Public Works of Chicago cleaned 2,538,483,925 square yards of streets by hand by the block and gang system, removing in the operation 417,146 cubic yards of dirt at a cost of $1,688,739, or 66.2 cents per thousand square yards or 61 cents per capita.

By the use of auto sweepers the department cleaned 49,103,038 square yards of street at a cost of $10,916, or 22 cents per thousand square yards. Auto flushers were used for cleaning 82,074,096 square yards of streets in the first ward (in which process there were used 19,092,790 gallons of water) at a cost of $12,642, or 15 cents per thousand square yards.

Catch basins were cleaned partly by hand and partly by auto educator machines. Hand cleaning was used for 15,006 catch basins at a cost of $62,014 or $4.13 per catch basin; while 28,052 catch basins were cleaned by machine at a cost of $63,102 or $2.24 per catch basin.

Refuse Disposal in Dallas

Dallas, Texas, with a population of about 185,000, produces 300 tons of rubbish per day by actual weight, which is collected without separation and hauled to a dump. The engineering department of the city, which has charge of the collection, prepared plans for incineration of the rubbish. These plans divide the city into four districts and place an incinerator in each district, in this way cutting the transportation cost to the minimum. The incinerators are designed large enough to burn all the collected material in from eight to twelve hours, thus eliminating all need of storage space, storage of garbage being always objectionable and unsanitary.

The amount of refuse collected in Dallas at present is stated by the city engineer, George D. Fairtrace, to average 1200 cubic yards a day, 1060 cubic yards of which is collected between the hours of 8 a. m. and 5 p. m., while 140 cubic yards is collected between the hours of 10 p. m. and 7 a. m. All the refuse has been weighed for the past 18 months and has averaged 500 pounds per cubic yard.

The collection is made in steel side-dump wagons or trailers by teams. The routing and other details are so planned that five trailers meet at one point, so located as to necessitate little additional haul after they have been filled, and at this point the tongue is unsnapped and he trailers are all hooked in a train behind a converted Ford tractor. This tractor has been hauling them to the dump, but when the four incinerators are in operation the trailers will be hauled to them.

Bids were received in September for the four incinerators and a contract was awarded for the construction of what is known as the Stokes type, several of which have been built in Texas, including four at Houston. One of the four Dallas plants will have a capacity of 80 tons in 12 hours and the other three a capacity of 40 tons in 12 hours. They are so located that the average haul on the refuse collected will be a little less than one mile, instead of the present average haul of 2½ miles to the dump.

It is the intention to operate the plants at present only 8 hours a day. There will therefore be room for taking care of increasing amounts of refuse by merely extending the length of time of operation per day. It was thought desirable not to figure on a 24-hour capacity because this would have required storage of sufficient refuse from the day collections to have continued the operation of the incinerator through the night, which would mean a storage capacity of two-thirds of the daily collection.

Mr. Fairtrace informs us that he is going to install at each incinerator a set of scales of the type known as motor truck, which will have a capacity of 10 tons and will be used for weighing all of the refuse that is burned in the city.

Sewage and Fish

Among the arguments for requiring cities to purify their sewage before discharging it into streams, the danger to the fishing industry is frequently referred to, but it is seldom that actual figures are given, nor does the argument itself often play a very important part in bringing about a decision in the matter. The New Jersey Fish and Game Commission in a recent report gives some figures which are of interest in this connection.

The value of the shad taken by the Delaware valley fishermen in 1920 was estimated at $88,377, while this year it has been only $28,985. This decrease is believed to be due to stream pollution. Another instance which would seem to be much more conclusive is that of the Maurice river. A few years ago practically no shad were found in this river, which received considerable sewage. In 1915 there was organized action against the pollution of the stream which resulted favorably, and this year 9,600 shad were caught in that river, it being the one stream in the state in which shad fishing was satisfactorily profitable this year.

Sewage is not the only pollution endangering fish. A new source of such pollution is found in the oil tankers and oil burners which dump their waste at sea or in the approaches to harbors and these are endangering the coast fisheries. An additional damage done by these oil burners is the pollution of the bathing beaches and also the endangering of shipping in the harbors, where the floating oil may and sometimes does catch fire.

Control of Tourist Camps in Florida

Sometime ago PUBLIC WORKS called attention to the desirability of oversight by local or state health authorities of the various camping sites being used by autoists throughout the country. Recently the state board of health of Florida issued a bulletin admonishing municipalities in that state to so supervise and manage the camps used by auto tourists as to make them both agreeable to the tourists and safe from a sanitary point of view, warning that unsanitary camps would be condemned as fast as found.

Says the bulletin: "Tourist auto camps are an institution in Florida. Whether these camps are good or bad for the community, they are here and must be supervised. During the winter season of 1920-21 there were many faulty camps in the state; the faults, however, were not so much with the camps as with the lack of supervision or management of them by municipalities wherein they were located. As a result of poor municipal supervision, many of the camps were grossly criticized, condemned and subsequently abandoned. In several cities ordinances were adopted prohibiting any further municipal camps."

Many towns advertised camps as a bid for tourists, but made no provision for keeping them sanitary. In some instances the camps were really used as homes by winter laborers. In some cases objection was found because commissaries were established at the camps and sold food to the campers at a lower price than it could be obtained at the neighboring towns.

"There were some excellent camps in Florida last year. The camp at Deland was a model, also that in De Soto park of Tampa. In the latter camp there were at all times about 1,000 campers under strict municipal supervision and everything went well. The cities of West Palm Beach and Bradentown have recently promulgated very business-like, comprehensive ordinances to handle camps. The West Palm Beach ordinance defines the limits of the camp grounds; it creates an office of camp superintendent with police and managerial authority; it requires that all tourists desiring to enter the camp apply to the superintendent, giving name of person in charge of party, number in party, permanent home address, make and number of automobile, length of stay in camp. A fee of 25 cents per day is charged for use of camp, this sum to go to a fund provided for the special service rendered the tourists in camp. The camp will operate in strict accordance with regulations of the state board of health. The ordinance goes into a number of details regulating the conduct of the tourists and the orderly maintenance of the grounds. In every way the ordinance is complete and under it the camp will be assured of decent supervision."

American Public Health Association

Fiftieth annual meeting and semicentennial celebration held in New York City, November 14th to 18th. Unusually valuable papers and discussions before the Sanitary Engineering Section.

The fiftieth annual meeting of the American Public Health Association was held in New York city during November 14-18th and was one of unusual interest and large attendance. Of special interest to municipal engineers were the sessions of the Sanitary Engineering Section. A number of those who were present informed the writer that the several meetings of this section were the most satisfactory to them of any meetings that they had ever attended for the discussion of sanitary engineering matters. All meetings began practically on time, the speakers were limited to ten or fifteen minutes, and abundant opportunity was offered for discussion. Under these favorable conditions, the discussions were participated in by a considerable number of the 60 to 100 who were present at each of the meetings, among which were to be found most of the engineers of state boards of health and the other leading sanitary engineers of the country.

Merely to look through the list at random reveals the wealth of information that was on tap at these meetings. Papers were presented by George W. Fuller, W. H. Dittoe, Paul Hansen, Kenneth Allen, T. Chalkley Hatton, A. M. Buswell, J. Frederick Jackson, Langdon Pearse, Stephen DeM. Gage, M. N. Baker, A. E. Fisher, George T. Hammond, John E. Skinner, Earle B. Phelps, George C. Whipple, I. S. Orborne, Rudolph Hering, Olin H. Landreth, Andrew J. Provost, Robert Spurr Weston, Allen Hazen, C. A. Emerson, C. E. A. Winslow, C. A. Holmquist, Samuel A. Greeley and others. Among those discussing the papers were Harrison P. Eddy, Glenn D. Holmes, E. S. Rankin, Abel Wolman, J. R. Baylis, P. H. Norcross, in addition to those already named.

The Tuesday afternoon session of the Sanitary Engineering Section was devoted largely to business matters. On Wednesday afternoon the members attended the symposium on "Stream Pollution and Sewage Disposal" at the rooms of the American Society of Civil Engineers; while on Wednesday evening at the same place there was a general discussion on "Odors and Their Travel Habits," in which the matter of odors from garbage disposal plants seemed to be most in evidence.

On Thursday morning "Water Supply, Water Purification and Sewage Treatment" were the subjects under discussion. On Thursday afternoon an article on "Stream Pollution," three on "Bathing Places and Swimming Pools," and one on "Mosquito Extermination" filled out the program. On Thursday evening there was a symposium in the A. S. C. E. rooms on "Water Supply and Water Purification," which, like the other symposium, was attended by more than 100 engineers and sanitarians. On Friday morning the final meeting of the session was devoted to papers and discussions on refuse disposal, mill supplies and the zoning of cities.

As to the papers themselves, they were of such unusual interest that we hope to be able to present many of them in the columns of PUBLIC WORKS, either in full or in abstract. The Wednesday afternoon symposium began with a paper by George T. Hammond entitled "Tanks and Fine Screens for Treating Sewage," in which Mr. Hammond gave some results of experiments made in Brooklyn as well as others, showing the relative effectiveness of screens and tanks in removing suspended matter.

This was followed by a paper by Kenneth Allen describing the pollution of the tidal water of New York harbor by sewage and the reduction during the past few years in the oxygen present, the indication being that in parts of the harbor waters a limit had been almost if not quite reached beyond which any increase in the amount of sewage would produce a nuisance. Storm water treatment, with special reference to the methods and plant details employed in Rochester, were described by John F. Skinner, who called attention to the importance of treatment of storm water under many conditions where such treatment is not ordinarily accorded it.

The policies of the Pennsylvania Department of Health were described fully and clearly by W. L. Steveson, assistant chief engineer of the department, who brought out the fact well-known by sanitarians that that state is among the most progressive ones in its treatment of problems of stream pollution, sewage disposal, etc.

The paper on the program entitled "Intermittent Stream Pollution" had not been prepared by Paul Hansen, as he had been prevented from preparing it or being present by serious illness.

The "Deposition of Sludges Resulting from Sewage Disposal Plants" was the title of the paper by T. Chalkley Hatton, which dealt with the results obtained at Milwaukee with Imhoff and activated sludge plants, together with some of the other types of tanks with which experiments had been conducted.

Langdon Pearse presented a paper entitled "The Dilution Factor" in which he briefly summarized the history of the effects to find a satisfactory expression for this factor. He concluded that, from the standpoint of sewage dilution, "The problem reduces to noting the amount of pollution to be handled and the amount of oxygen available plus re-aeration." The paper will be published in full in PUBLIC WORKS within the next two or three weeks.

W. H. Dittoe, chief engineer of the Ohio state department of health, called attention to the abuse of sewers, especially those of the separate system, which were found in a number of cities of Ohio, this abuse being chiefly that of connecting water leaders to the small sewers, which resulted in overburdening them and sometimes in the flooding of the cellars of connecting buildings. On the other hand, house sewage was sometimes found discharged into storm-water sewers. The situation had become so serious that the idea was even considered of entirely abandoning the use of separate systems and building all sewers on the combined system. He suggested however, as a possible remedy that cities make all connections to sewers by their own employees, or by licensed plumbers who would be held responsible for the occurrence of any such unauthorized connections. Discussion of this paper was taken part in by Harrson P. Eddy, Glenn D. Holmes, J. Frederick Jackson, Dr. Rudolph Hering, E. S. Rankin and some others. Dr. Hering stated that he believed Oxford and Reading were the only cities in England that were constructing sewers on the separate system. Mr. Rankin stated that the older section of Newark was sewered on the combined system but some of the newer sections on the separate system, and that the failure of owners in the separate system districts to understand why they should not have the same privilege of connecting rain water leaders to sanitary sewers as those in the older part of the city had lead to a considerable misuse of the smaller sewers in the way indicated by the paper.

Thursday morning's session opened with a paper by George W. Fuller giving a review of "Sanitary Engineering During the Last Fifty Years," in which it was brought out that sanitary engineering really had not existed as a science fifty years ago, the germ theory of disease had not been established and the art of filtering water was practically unknown in this country.

"The Proper Size of Sand for Rapid Sand Filters" was discussed by W. H. Dittoe; in which he explained why the Ohio state department of health was insisting upon the use of fine sand in the construction of filtration plants in that state. He classed as "coarse," sands with an effective size of more than 0.6 mm. and as fine those of 0.45 mm. or less, and stated that results from filters using the former size were not uniformly acceptable, while those using the fine sand averaged up very much better. The effective size which they recommended for filter sand was between 0.35 and 0.42, with 1.8 as a desirable co-efficient of uniformity. This led to some discussion of sand sizes, sand stratification in beds by use, the significance of effective size and uniformity coefficient, etc. Mr. Dittoe stated that they considered that a plant should produce, under the worst conditions of water, absence of gas in 10 cc. samples at 37 degrees, for 24 hours in lactose broth; also that each part of a purification plant should take its appropriate share of the burden with satisfactory efficiency and without overloading. It was recognized, however, that in any case probably 5% of the samples would show gas, but the number should not exceed 20%. He stated that a large part of the efficiency of the Ohio plants was undoubtedly due to the expert operation which they received, at least 15 of them being in charge of the men of the highest technical efficiency.

Wellington Donaldson read a paper entitled "Industrial Wastes in Relation to Water Supplies," in which he told of several ways in which industrial wastes might affect supplies, such as by clogging filters, by lessening of effect of coagulants (as is done by tannery liquors), lessening of effect of chlorine or causing it to give a taste to the water. Also the poisoning of supplies, as in the case of lead, arsenic, etc.

Further information concerning the experiment on sewage treatment at Milwaukee was given by Mr. Hatton in a paper entitled "The Use of Centrifuges for Dewatering of Sludge." Mr. Hatton believes that, while a perfectly satisfactory solution of sludge dewatering has not yet been discovered, the appliances which have been tested have shown that it is perfectly practicable to prepare sludge for use as a fertilizer or other methods of utilization.

A year or two ago an experimental plant consisting of a Dorrco screen and a Dorr-Peck activated sludge tank was installed at Urbana, Ill., by the Illinois water survey, and this plant and the results obtained from it so far were described by A. M. Buswell, chief of the water survey, who showed on the screen photographs and diagrams of the plants and tabulated data of the result.

In the afternoon, following a report of committees, papers were read by J. Frederick Jackson on "Correlation of Stream Pollution Criteria from Studies of Naugatuck and Hockanum Rivers in Connecticut"; by George W. Simons, Jr., giving a report of the committee on bathing places; by Stephen DeM. Gage and Attmore E. Griffin discussing "Sanitation of Bath Houses at Public Bathing Beaches"; by W. F. Walker describing installations for "The Treatment of Swimming Pools by Ultra-Violet Rays," and by W. V. Becker giving "Suggestions for the Extermination of Mosquitos."

On Friday evening another symposium was held at the rooms of the American Society of Civil Engineers on "Water Supply and Water Purification." At this symposium Prof. George C. Whipple gave an excellently condensed but complete "History of Water Purification." This was followed by a paper by Allen Hazen entitled "Relation of Character of Water to Design of Water Filtration Plants." In this paper Mr. Hazen gave special emphasis to the desirability of purifying water without chemicals, at least under certain conditions where an "active" water would produce undesirable results, such as attacking pipes and other metal structures.

"Interference with Water Filtration Plant Operation by Wastes from By-product Coke Ovens and Gas Works," a problem which affects a considerable area of Pennsylvania, was discussed by C. A. Emerson, Jr., chief engineer of the Pennsylvania department of health. Mr. Emerson showed how considerable amelioration or elimination of these difficulties had been obtained in certain plants by their using the waste waters repeatedly in cooling or other processes about the plant until evaporated, instead of discharging them into the river.

Prof. C. E. A. Winslow, in a paper entitled "Reduction in Typhoid Death Rate," presented an analysis of figures for the typhoid death rates during the past decade, both in the country at large and in the registration area, which apparently indicated that in the latter the reduction in typhoid death rate had been greater in the rural than in the urban districts and was at present lower in the former than in the latter; a condition which is exactly the contrary to that which has ordinarily been believed to exist. This was followed by a paper by C. A. Holmquist showing how the typhoid death rate in New York state had been reducted very greatly by water purification and improvements in the water supplies of the state, there having been a continuous, although of course diminishing, decrease in rate since the state board of health had begun to exert its influence in the matter.

"The Purification of Soft, Colored Waters" was discussed by Robert S. Weston, who described how some of the New England waters, many of which are at present more highly colored than those of most other sections of the country, can have their coloring matter eliminated to a large extent. The papers concluded with one by Samuel A. Greeley entitled "The Operation of Reservoirs for Water Supply"; following which there was a very interesting discussion for half an hour or so on the papers of the evening.

The final session of the sanitary engineering section was held on Friday morning, opening with a report of the committee on refuse disposal by M. N. Baker, in which was given a brief statement of the present status of refuse disposal and a comparison of the methods which are available, reference being made to Hering and Greeley's book on "Collection and Disposal of Municipal Refuse" as the most important feature of the year in this branch of engineering. A paper by E. A. Fisher describing "The New Garbage Reduction Works at Rochester" was read by John F. Skinner in the absence of Mr. Fisher. This gave a condensed general description of a plant embodying the Cobwell system of reducing garbage which has just been completed in Rochester. This was followed by a discussion on the subject of garbage disposal in which a number of members took part. Mr. Hatton stated that a few months ago, while visiting Berlin, he had learned that the method of burying garbage which had been followed by that city for several years was no longer considered satisfactory because of the long haul involved and the large area of land thus withheld from intensive cultivation and occupation as a residence district. It was stated that in Chicago a reduction plant is operated by the city at a loss (see page 412 of this issue); also that the health board did not consider the garbage in any way a health matter, even if it was simply piled up in the back yards and not removed at all.

The balance of this session was occupied with a report of the committee on milk supply by H. A. Whittaker and a paper on "The Physical Effects of Pasteurization and Other Temperature Treatments of Milk" by Drs. Heulings, Pease and Towne; and a paper by Charles B. Ball entitled "The Health Value of the Zoning of Cities."

Hiram F. Mills' Engineering Bequests

The late Hiram F. Mills, Hydraulic Engineer, left several bequests to engineering interests, including $10,000 to the Reneslaer Polytechnic Institute and the Massachusetts Institute of Technology, $2,000 to the American Society of Engineers, $1,000 to each of the New England Waterworks Associations and the Boston Society of Civil Engineers and $5,000 to the American Academy of Arts and Sciences besides the bequest of $200,000 to Harvard University to establish a fund for the investigation and origin and cure of cancer as a memorial to Mrs. Mills.

Freezing of Concrete

The Engineering Experiment Station of the University of Illinois has just published a bulletin entitled "Studies on Cooling of Fresh Concrete in Freezing Weather," by Tokujiro Yoshida, being Bulletin No. 123 of the series published by the station.

The practice of placing concrete in freezing weather renders important a knowledge of the rate at which this material will cool, and the effect of the various methods of protecting the freshly placed concrete from the cold.

This bulletin deals with certain experimental work carried on at the Engineering Experiment Station of the University of Illinois with the object of obtaining data on the length of time required for concrete of a given temperature to lose its heat and become cold enough to freeze when it is exposed to temperature lower than the freezing point of water. Some experiments were made on the protective effect of coverings.

While it is probable that these experiments do not give complete data regarding concreting in freezing weather under all possible conditions, it is considered that they throw some light on the behavior of fresh concrete at low temperatures, and indicate the necessity of protection or other precautions.

Copies of Bulletin No. 123 may be had without charge by addressing the Engineering Experiment Station, Urbana. Illinois.

Substitutes for Cut-Back Asphalt Cement

During the war cut-back asphalt cements were almost unobtainable for road making purposes and in 1918 the Committee on Broken Stone and Gravel Roads of the American Society for Municipal Improvements presented a specification known as "Temporary Substitute for Road Oil," which was for a cold application to be used on such roads. This substitute was described on page 362 of the Proceedings of that society for 1918.

Considering that the cut-back material is still quite expensive, although there are now no restrictions placed upon the use of it by the government, and in view of the fact that most excellent results have been obtained by using this substitute material, the committee this year recommended to the society at the Baltimore convention that the specifications be retained as a part of the standard specifications of the society. The cut-back asphalt cement for which this is a substitute consists of a mixture of asphalt cement and naptha. The specifications require that in the case of the cut-back cement, when tested by means of the Engler viscosimeter at 25 degrees Centigrade, the specific viscosity of the first 50 c.c. passing the orifice of the viscosimeter shall be between 25 and 35, while the similar test of the substitute would have a range between 80 to 120.

To Purify Kaw River, Kansas

A few weeks ago, the state board of health of Kansas called a conference of representatives of 13 Kansas towns to discuss the proposition of preserving the purity of the water of the Kaw river. Dr. S. J. Crumbine, secretary of the state board of health, said that with the increase in population of the cities along the river the pollution of the river was increasing, and the time might come when it would be necessary for the cities to treat their sewage. Apparently the object of the board was to urge the towns to take such precautions as they could in order to postpone as long as possible the time when the construction of sewage disposal plants would become necessary.

PUBLIC WORKS

Published Weekly
at 243 W. 39th St., New York, N. Y.

S. W. HUME, President J. T. MORRIS, Treasurer

Subscription Rates
United States and Possessions, Mexico and Cuba $3.00 year
All other countries ....$4.00 year
Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Byrant 9591
Western office: Monadnock Block, Chicago
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A Successful Convention

The average engineer, we believe, attends conventions of his professional societies with two main objects in view—obtaining information and meeting his fellows in the profession. Those who present papers do so because urged to it by the officers, or because of the favorable attention such papers direct to themselves, or for both reasons.

In too many conventions the meetings do not begin promptly at the appointed time, as a consequence of which much of the time of the members is wasted and few are present during the first few minutes of each session. The papers are not limited in length, and some long-winded speakers monopolize the time and crowd out discussion, the meetings lack "pep" and drag along, and much of the benefit that might be contributed by the discussions is lost.

The convention of the American Public Health Association, Sanitary Engineering Section, and the symposiums arranged by the American Society of Civil Engineers in connection therewith, were as nearly models as any meetings the writer has attended in a long time. The sessions began promptly at the hour set, papers were limited to ten or fifteen minutes (and it is remarkable how much can be said in that time if the writer has taken pains to condense his paper and knows that its length is limited) and discussions limited to shorter periods. Although 9:45 A. M. seemed late to begin, the morning sessions *began* at 9:45, which is more than can be said for 9 o'clock sessions in some societies; and the hour before this, and especially the time before the 7:45 P. M. session, was free for social and professional conversation by even those who were conscientiously prompt in attending the formal sessions.

And the papers were well worth while. The committees had apparently seen to that and obtained discussions on timely topics from recognized specialists in the several lines. To the sanitary engineers who were present, at least, the convention was a most successful one and several stated to the writer that it was the best of any they had ever attended.

A Sanitary Section of the A. S. C. E.

Several members of the American Society of Civil Engineers who specialize in sanitary engineering have, for two years past, been meeting together at a dinner held during the annual meeting of that society, for an interchange of ideas to their mutual advantage and pleasure. The success of the Sanitary Section of the American Public Health Association has suggested the desirability of a similar section in the A.S.C.E.

The latter society is abundantly large to permit of sectional meetings to advantage, and the interests of the members are so diversified that very few subjects of discussion are of interest to more than ten to twenty-five percent of the members. There thus occurs a natural segregation into unofficial sections in the attendance at the meetings, and there would seem to be several advantages in recognizing this officially by the formation of sections, which would meet separately and have each its own chairman and secretary. We hope the matter will be given careful consideration between now and the time of the annual meeting.

"Sanitary Sewers"

There are no accepted autocrats in language, but the majority of the intelligent people decide what words the lexicographers shall from time to time add to their dictionaries, and what meanings they shall give them.

The editor of PUBLIC WORKS bows to this majority. For twenty years he has advocated what he considered to be a consistent use of the terms "house sewer" and "storm sewer" to designate the conduits receiving the waste water from houses and rain water run-off respectively. During fifteen years of this time a majority, probably, of the students of sewerage in engineering schools have used as a text book, "Sewerage," in which this use of the terms is employed, and during the past ten years committees of at least two national organizations have advocated such use and declared the use of the term "sanitary" sewer to be supported by no logical argument.

In spite of this, the term "sanitary sewer" seems to have been adopted for general use by the younger engineers. Most recent papers before societies, municipal reports and other writings of engineers employ it. If we and they are to understand each other we must use the same language. And although the term *sanitary* sewer seems to us an absurdity, we will use it in the future in this publication in order to conform to the usage of the majority.

How to Select, Install and Operate a Concrete Mixer

Permanent equipment required on all kinds of construction work demands most efficient, durable and standard machines. Number, size and type depend on local conditions, amount and character of work. Operations should be continuous and to fullest Capacity. Ordinary difficulties can be averted or corrected

Most experienced contractors have one or more favorite makes of mixer, which are often replaced by duplicate orders whenever any of them are worn out or additional ones are needed. It does not, however, follow that the selections, often made casually at first, are the wisest. It would be well for all contractors to pay careful attention to the subject, determine what are the best sizes and makes of mixer for them to use, and why they should be used and govern themselves accordingly in future purchases of equipment. In this way they can, without extra cost, make their plants conform to a fixed policy and have their machines ultimately standardized and duplicated to secure the highest efficiency and economy, matters of importance to contractors commencing to accumulate equipment and gain construction experience and reputation.

Although it is possible to mix concrete well by hand, it is generally discouraged and often prohibited by specifications, except in very small quantities or in isolated positions where the installation of a machine would be very difficult or expensive. The facts that the work can be done much more rapidly, efficiently and continuously by a machine and at a unit cost greatly below that of hand work, and that the use of the machine eliminates a large amount of sometimes unreliable hand labor, make a mixer the first requirement of every contractor. A concrete mixer can be used, not only to mix concrete, but various other substances, especially mortar, not to speak of the use to which one is put on Long Island where one of the machines is installed to mix the feed of an enormous number of ducks raised for the Metropolitan Market. These machines or modifications of them are also successfully used for mixing plaster, fertilizer, and various other materials.

CONCRETE MIXERS

For their fullest efficiency continuous mixing machines should be equipped with large storage for cement, aggregate and water and reliable automatic measuring and delivering service and abundant facilities for continuous distribution of the finished concrete. In case of necessity these machines can, of course, be operated intermittently and have separate measured quantities of materials passed through them as in an ordinary batch machine, but such operation eliminates the special advantages the machine is designed to secure without giving those specific to the batch machine. An early type of this machine, now seldom used, consisted simply of a long open trough, with concentric revolving shaft having radial arms or blades, pitched to move the material from one end of the trough to the other somewhat after the principal of a worm conveyor.

Another continuous machine of very simple construction, that could be made by ordinary mechanics, consists simply of a long vertical or steeply inclined chute or tube provided with interior baffle plates, projecting arms or their equivalent. The materials being emptied into a hopper at the top of the mixer fall by gravity to the bottom and in transit are thrown from side to side and more or less thoroughly mixed in their descent.

Another type of gravity machine that, although used as a batch machine, might be uninterruptedly supplied with measured quantities of materials and operated as a continuous machine, is the multiple hopper machine, in which a series of hoppers are vertically super-imposed and the materials falling from one pyramidal or conical hopper into the one below are more or less completely turned over in the descent and are mixed wholly by the transverse motion and rolling effect of the downward and sideways progress of the heavy charge moving wholly by gravity. It is claimed that it is turned over in passing through each of the three or four hoppers to the receiving hopper below.

These machines are simple in construction and can be built of any required dimensions, but like other gravity machines, cannot provide for any variation or modification in the manner or duration of the mixing. All gravity machines are obviously subject to the universal law that it is impossible to get something for nothing and as the efficiency of mixing must correspond in at least a minimum expenditure of power in the mechanical operation, it must require a certain considerable height of fall and very efficient turning over appliances to equal the rolling and pitching and kneading effect of power machines.

REVOLVING MACHINES

Batch machines are mostly of the revolving type, and constitute a very large proportion of all machines used in this country. They generally have a capacity of from ¼ cubic yard up to a maximum of 4 or 5 yards. They receive a premeasured quantity of materials and, unless cubical, are equipped with fixed or moveable interior blades, projecting from the inner surface of the drum that are so arranged as to lift and shift and drop the aggregate as the drum revolves, producing a rolling and even kneading action that is very efficient and usually suffices for a satisfactory mixture after 10 or more revolutions of the drum occupying from ½ a minute to 2 minutes according to requirements. The average time being about 1 minute of actual mixing. In some types the machine is both charged and discharged while in revolution and in others, as in the cube, it must be stopped to receive the material and discharge the concrete.

For several years efforts have been made to mix concrete by the forces provided for its transportation, especially when the aggregate is stored and measured at a distance from where the concrete is placed. There is now on the market a machine, mounted on an auto truck and operated by the regular engine of the latter, that is changed by gravity from elevated bins, mixes the concrete in transit, preferably at the end of the route, and dicharges by gravity through a chute that may be moved by the truck as it delivers so as to speed the concrete.

PNEUMATIC MIXERS

Within a few years considerable attention has been devoted by prominent manufacturers to the development of pneumatic mixing machines in which the concrete shall be mixed by the operation of jets of compressed air in a closed chamber. These have been usually operated in connection with pneumatic conveying apparatus, by which the mixed concrete is forced through a 4 to 8-inch pipe to the required position in the forms. Both operations require a considerable amount of compressed air and therefore involve a compressor plant that is expensive to install and operate for mixing purposes alone, so that the pneumatic mixer is usually best adapted to situations in which there is very little working room and it is important to avoid obstructions, as particularly in small tunnels.

For general purposes the revolving type of batch machine is satisfactory and several makers have developed it to a high degree of efficiency and economy, but the other types have been useful and will be useful when conditions make them more convenient or are especially suited to their peculiar features.

SELECTION OF MIXER

Unless it is required for a job of such great magnitude or duration that its execution outweighs all other consideration, the concrete mixer should be selected with a view to its future use on the character of work that the contractor is likely to undertake thereafter. In any event the machines should be simple, efficient, powerful and durable, of high class materials and workmanship and easily operated. It should be of simple and sturdy construction and easily assembled, and should be supplied with spare parts of any sort that may be especially likely to failure or rapid wear so that they can be replaced with the minimum cost and delay if necessary, but in a first-class machine such replacements are rare and with good care the machine will operate for a long time without danger of breakdown.

It is, however, advisable that the machines should be all of one standard make and if possible of only one or two sizes, so that a few spare parts may serve for the entire equipment and that the operators soon become thoroughly familiar with the machines and their requirements and are not confused by shifting from one machine to another.

It is also important that the machines be fitted for operation with steam, gasoline or electric power as may be most desirable, and at present the gasoline motors are likely to be most convenient and economical in a majority of small or moderate size jobs.

The tendency at the present time is strongly toward the use of multiple units of small capacities rather than of very large machines, and the extremely small machines down to a capacity of ¼-cubic yard per batch are increasingly popular, although a great many machines of ¾-yard capacity are in use. For special work where a very large amount of concrete is to be placed in one mass, as for instance in huge ship canal locks, great foundations or enormous dams where provision is made for handling the concrete continuously through chutes or in large conveying apparatus, one or more especially large machines are sometimes installed.

Ordinarily, however, a number of small machines is better for various reasons. They are carried in stock and can be quickly purchased and delivered. They are very much lighter and the freight charges are less. They are more easily transported, handled and installed. They require no costly foundations and can be set on their own trucks or on timber sills. The use of a battery of mixers is substantially equivalent to maintaining reserve equipment, since only one of a number of mixers is thrown out of service and the rest may continue in operation while the one is repaired. They are far more flexible and can be shifted from point to point on the job or when the bulk of the work is done a part of them can be moved and put on other work; they can be easily moved so as to receive aggregate directly as it is brought to the site. They are more saleable at the close of the job and have a higher cash value than large machines.

MOVEABLE MIXING PLANTS

The smallest size machines are frequently mounted on wheels so that they can be easily moved by hand for moderate distances over level ground. They may also be placed on skids that serve not only to shift them from place to place, but answer as settings for them while in operation.

For special purposes a small machine has been mounted on a motor truck equipped with storage for cement, water and aggregate for a few yards of concrete and is thus quickly available for operations at any remote place or for immediate repair or urgent service of any kind, carrying all of the necessary equipment for doing a small job with a crew of men that accompany the trucks and are not required to wait for delivery of machinery or material. In case the job requires more concrete than the supply from the storage on the trucks the quantity can easily be doubled or trebled by hauling it on a trailer or by a service truck provided for the special purpose.

Whenever a considerable amount of work is done on the waterfront it is generally desirable to install the mixer or mixers on one or more barges that can easily be fitted with loading, unloading and hoisting apparatus and very readily shifted from point to point with only a few feet at once to keep within the most convenient distance of the work in order to deliver the concrete directly to it by derricks or by spouting. The barge may have storage for a considerable amount of cement and aggregate, but is frequently provided only with small service hoppers that are filled from a material scow alongside, which can be replaced as often as necessary and enable the small hoppers to always provide immediately supplies by gravity to the mixers.

Similarly traveling plants may be installed on shore and have a platform on which the mixer is set with service storage bins alongside and usually the derrick to maintain the latter filled with aggregate, the whole equipment being easily moved on a broad gage track as required. An equivalent of arrangement is provided by the installation of the mixer, storage bins and loading and unloading apparatus on a railroad car that may be supplied with aggregate from tenders brought alongside or in the same train with it and served by hand or power.

(To Be Continued)

Proposed Brooklyn--Richmond Tunnel

$141,000,000 commercial development scheme for a belt railroad, serving Brooklyn, all of Staten Island, and a large territory in New Jersey with a tunnel under the Narrows and a high level bridge across Arthur Kill

In 1921 the legislature of New York directed the Board of Estimate and Apportionment of New York City to construct a freight and passenger tunnel connecting the boroughs of Brooklyn and Richmond in Greater New York. A preliminary report on the construction of the tunnel and its connections has been made by representatives of the Pennsylvania, Long Island, and Baltimore & Ohio Railroads and the Board of Estimates' committee.

This report points out the impracticability of developing existing railroad lines to serve the tunnel and for the transfer and distribution of freight connected therewith, and recommends in a general way the construction of a belt line railroad which would serve a large territory in New Jersey, the whole of Staten Island, the western end of Long Island, and reaching to Manhattan Island, provide connections with all existing railroad systems through New York, and, with the tunnel across the Narrows and a high level bridge across Arthur Kill from Staten Island to New Jersey insures ample physical connection with the mainland. It provides for a large classification yard in the borough of Richmond and gives alternate locations for the alignment of the tunnel and for the road crossing Staten Island. The total cost of the project is estimated at $141,000,000. The Committee recommended that application be made for the authorization of borings, the preparation of plans, and the approval of construction types.

The plans provide for connection with the railroad systems above mentioned, and with the New York Central and with the New York, New Haven & Hartford Railroads and for an industrial railroad traversing the intensively developed Brooklyn water front along the upper bay, facilitating industrial development in Jamaica and Flushing and districts and the Bronx and providing for connections with the $20,000,000 municipal piers on Staten Island and rail service for ever Borough of the city.

The comparisons of plans and estimates for fifteen separate and distinct routes having 1 percent and 2 percent maximum grades indicated a saving of $15,000,000 for the construction of the 2 percent maximum, which was therefore recommended. Consideration was also given to the construction of the tunnel made by the twin tubes method, by the shield driven method, and by the trench method, between which no final choice has yet been made. It has been established, however, that the tunnel is entirely practicable and with its terminal connection can be built at a cost of about $51,000,000.

A freight traffic of 22,500,000 tons annually is estimated from the records for 1914, plus the assumed increase of 2 percent yearly; it is also assumed that the 1918 cost of $9.50 per car for handling the freight will be reduced to $3.75 per car, a saving, which after paying the fixed charges of the project, is estimated at $5,000,000 annually.

The principal advantages claimed for the project are that it will effectively serve the entire length of Staten Island; provide for economy of construction and operation of the classification yards; permit advantageous trench construction of the tunnel; provide for future rail connections with the New Jersey water front at Constable Hook; provide passenger service for the most populous part of Staten Island; is not likely to be opposed by property owners in Brooklyn; minimizes possibility of interference with future water main crossings of the Narrows; obviates the necessity of negotiating with holding companies concerning franchises for rights in connection with the main freight project; affords military protection in time of war; will develop dormant areas in the outskirts of the metropolitan districts; will unify terminal service of 10 trunk lines; will afford freedom from harbor interruptions due to fogs, storms, ice, high tides, and marine strikes; will provide work for unemployed labor and capital; and will virtually transform New York from an island to a mainland city.

Long Span Ohio River Highway Bridge

Work has been commenced by the Dravo Construction Co., Pittsburgh, on the $250,000 substructure for a highway bridge across the Ohio River from Ironton, Ohio, to Russell, Ky., that will have an estimated total cost of $700,000.

Besides viaduct approaches and the 200-foot shore spans the river crossing will consist of two 350-feet anchor spans and a 725-foot cantilever that is somewhat remarkable for its proportions of 175 feet for the cantilever arms and 350 feet for the suspended span. The bridge will have riveted trusses 29 feet apart on centers and a wooden plank roadway floor 20 feet wide and about 100 feet above normal water level. The three reinforced concrete river piers have I-shape cross sections with shallow foundations on bed rock.

Recent Legal Decisions

A SCHOOL DISTRICT IS A MUNICIPALITY

The word "municipal" as originally used in its strictest sense, applied to cities only, but now has a much more extended meaning, and when applied to corporations, the words "municipal," "political," and "public" are often used interchangeably. The Pennsylvania Superior Ct. 305, that a school district is a quasi corporation for the sole purpose of administering the Commonwealth's system of public schools, and vitally associated with the education of children in protecting their health, so that it is reasonably embraced within the designation of "municipality." As such, it is within the statute requiring compulsory vaccination for the public health in the "several municipalities" of the Commonwealth.

LEGAL WIDTH OF STREETS—POWER TO WIDEN AND ASSESS OWNERS

A city street was originally dedicated by a property owner at a width of thirty feet. Subsequently the city sought to increase the width by an ordinance locating the street at a width of forty feet. This ordinance, however, was held invalid as an attempt to widen an established street without proceeding in the manner required by the statute. Sometime afterwards, the city paved the street at the original width of thirty feet, as dedicated. The board of viewers assessed an abutting owner's property for benefits. The owner objected on the ground that the legal width of the street was forty feet, and that the city had no right to improve it at a width of thirty feet. It was held, Sborigi's Appeal, 75 Pa. Superior Ct. 145, that the ordinance widening the street having been declared invalid, the original width as dedicated was the legal width, and the assessment was properly made.

DAMAGES FOR FAILURE TO DELIVER SITE TO CONTRACTOR IN TIME AND FOR CHANGE IN PLANS CAUSING EXPENSE AND DELAY

The federal district court for the Northern District of Ohio holds, Bates & Rogers Const. Co. v. Board of Commissioners, 274 Fed. 659, that a contract for the construction of approaches to a bridge carries an implied covenant to furnish and deliver the site in a condition to permit the work to be done, and that a failure so to do is a wrongful breach of the contract, for which the contractor may recover damages. Where there was no express provision when the site would be so delivered, it was implied that it should be ready for delivery either on execution of the contract or within a reasonable time thereafter. And where the work was to be done according to plans and specifications then on file, the contractor might recover when a subsequent change in the plans was made to meet new conditions and improvements not in contemplation of the parties when the contract was executed, requiring excavation to a greater depth and modification of design of certain parts of the work to be done, and thereby causing great delay in the completion of the entire contract.

POWER TO SELL CITY'S REAL ESTATE AT PUBLIC AUCTION—EMPLOYMENT OF AUCTIONEER

The Ohio Supreme Court holds, State v. Carrel, 132 N. E. 161, that a city under Ohio Gen. Code, §3699, has power to sell at public auction real estate belonging to it when such real estate is no longer needed for municipal purposes. But, the section providing that the contract shall be made in writing by the officer having supervision or management, and only with the highest bidder, which officer may reject any or all bids, it is thereby made the duty of the officer to attempt to make the sale, and, it being required of him as an official, the city has not the power to employ and pay an auctioneer to make the sale.

VACATION OF STREETS—BENEFITS TO PRIVATE INTERESTS

The Illinois Supreme Court holds, People v. Elgin, J. & E. Ry. Co., 132 N. E. 204, that the presumption of law is that the public officials constituting the city council discharge their duty to the public, and the courts will not declare an ordinance vacating a street void merely because some private interest may be served by the vacation. It must clearly appear that no consideration of public interest could have led to its enactment.

COUNTY ROAD WORK IN NEW JERSEY

Through the courtesy of the secretary of the New Jersey Association of County Engineers, Harry F. Harris, we have received a statement of the amount of work done by 19 of the 21 counties during the year 1921. These figures do not include any work done by the state highway department, nor work on the state highway system carried on by the counties under the Reimbursement act, which permits the State Highway Department to allow counties to proceed with work on the state highway system and reimburse them three or four years later, or whenever state funds are available.

These figures show that 204 miles of roads of all types had been completed by October first and that 53.8 miles were still under construction and 9.4 miles under contract ready for construction.

Of the roads already completed, 11.12 miles were of sheet asphalt on concrete base, 17.43 were sheet asphalt on stone base, 23.98 were bituminous concrete on concrete base, 15.18 were bituminous concrete on stone base, 43.91 miles were concrete, 0.46 were brick, 1.11 were stone block, 12.22 were penetration macadam, 21.22 were waterbound macadam, and 57.32 were gravel.

Of the amount under construction, 4.66 miles is sheet asphalt on concrete base, 4.30 sheet asphalt on stone base, 3.10 is bituminous concrete on concrete base, 3.15 is bituminous concrete on stone base, 7.57 is concrete, 3.33 is block, 2.03 penetration macadam, 25.04 is gravel and 0.61 is other types. Of the roads under contract ready for construction, 1.61 is sheet asphalt on concrete, 1.42 is concrete, 0.66 is block, 2.53 is waterbound macadam and 3.20 is gravel.

These figures show that the various bituminous roads constitute 31.64% of the total, concrete constitute 19.78%, and penetration and waterbound macadam 14.22%.

NEWS OF THE SOCIETIES

Nov. 28-29—KANSAS CITY SECTION AEMRICAN SOCIETY OF MECHANIICAL ENGINEERS. Two-day regional meeting. Secretary, Louis Bendit, 517 Finance bldg.

Dec. 1-3 — MONTANA IRRIGATION AND DRAINAGE INSTITUTE. Great Falls, Mont.

Dec. 5-8—AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS. Omaha, Neb. Secretary, J. H. Mullen, St. Paul, Minn.

Dec. 5-9—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual convention. New York City.

Dec. 6-9—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 14th annual meeting. Baltimore, Md.

Dec. 13—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary, N. L. Nussbaumer, 80 W. Genesee Street, Buffalo.

Dec. 14 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' building, New York City.

Dec. 15—ENGINEERS' CLUB OF CINCINNATI. Cincinnati.

Dec. 22-23—KANSAS ENGINEERING SOCIETY. Annual meeting. Hutchinson, Kan. Secretary, J. M. Averill, Topeka.

Dec. 22-23—KANSAS ENGINEERING SOCIETY, Hutchinson, Kan.

Dec 27-31 — AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, SMITHSONIAN INSTITUTE, Washington, D. C. Toronto, Canda.

Jan. 4-14 — CLEVELAND, OHIO, BUILDING EXPOSITION. Municipal auditorium, Cleveland, Ohio.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING. 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' building, New York City.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention, Curtis Hotel, Minneapolis.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

AMERCIAN SOCIETY OF CIVIL ENGINEERS

The program for the adjourned November meeting of the Society, was divided into three sessions for the discussion of important topics at the afternoon meeting.

November 16.—There was a Symposium "Stream Pollution and Sewage Disposal." Speakers—George T. Hammond, Kenneth Allen, John F. Skinner, W. L. Stevenson, Earle B. Phelps, Paul Hansen, W. K. Dittoe, Langdon Pearse and T. Chalkley Hatton.

November 16, 1921, 8 p.m. — The Monthly Business Meeting was followed by a paper "Odors and their Travel Habits," by L. L. Tribus, published in August "Proceedings." Discussion led by George C. Whipple, Stephen De M. Gage, J. S. Osborn, Rudolph Hering, Olin H. Landreth, Andrew J. Prevost, and Robert S. Weston.

November 17 — Symposium, "Water Supply and Water Purification." Speakers—George C. Whipple, Allen Hazen, C. A. Emerson, C. E. A. Winslow, C. A. Holmquist, Robert S. Weston and Samuel A. Greeley

FALL MEETING OF NEW JERSEY ASSOCIATION OF COUNTY ENGINEERS

Members of the Association and guests left Trenton 9.00 a.m., November 18th, via. Automobiles and inspected Brunswick Pike in Mercer and Middlesex Counties, and proceeded to Clarksville to Lawrence Station, to Mercerville, Hamilton Square, Route No. 1, to Hightstown, to Manalapan, passing over State Maintenance work; turn left, Manalapan to Englishtown, passing Molly Pitcher's well, and Monmouth Battlefield, thence to Freehold, and inspected interesting Monmouth County work thereabouts.

After luncheon at Lakewood, the party visited hangar built by Navy Department near Lakehurst for ZR-2 and proceeded over gravel roads through Monmouth, Burlington and Atlantic Counties, along Jersey Coast, dining at Sea View Golf Club, between Oceanville and Abescon. Inspected nearby New Highway Lighting Scheme of General Electric Co. and held meeting at 9.00 p.m. at Hotel Dennis, Atlantic City. Saturday visited Atlantic County bituminous work during morning. Lunched at Bridgeton Country Club and in the afternoon inspected State work.

The following subjects were announced for discussion at the meeting:

Advisability of Counties building part of State Highway System under Reimbursement Act, as proposed by Highway Commission.

Exchange of ideas with Delaware and Pennsylvania Engineers.

Reports of Standing Committees.

Proposition of admission of Assistant County Engineers as Associate Members of New Jersey Association of County Engineers.

Establishment of a Clearing House for use of members of the Association, to be conducted by Secretary.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION

At the New York meeting of the Association, October 18-20, there was a record attendance and considerable attention was paid to the labor situation, involving large threatened strikes that were discussed by the presidents of the Central Railroad of New Jersey and of the Delaware & Hudson Company. A formal resolution was passed deploring the threatened railroad strike and expressing the loyalty of the association to the railroad service.

Among the principal committee reports were those on cinder pit construction that covered the deterioration of concrete pit walls, due to the action of hot cinders, and the use of fire brick lining. The committee on lining tunnels under traffic made a voluminous report, containing descriptions of important examples of re-lining timber lined and brick lined tunnels with concrete.

ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS

The November 16th meeting of the Associated Engineering Societies of St. Louis was held under the auspices of the St. Louis branch of the American Society of Mechanical Engineers. C. C. Smith, chief engineer of the United Construction Co., gave an illustrated address on "The Construction of a Million Barrel Oil Refinery at Fall River, Mass., for the New England Oil Corporation," and D. A. Garber, past president of the Associated General Contractors, spoke on "How to Keep Engineers Steadily Employed."

BOSTON SOCIETY OF CIVIL ENGINEERS

The Boston Society of Civil Engineers held a meeting on November 16th, the subject of which was "Labor Problems of Today." There were addresses by James Gould, Carpenters' District Council; John T. Walsh, president of the Building Trades Council, and E. A. Johnson, secretary of the Building Trades Council, as representatives of organized labor. Participants in the general discussion were William Stanley Parker, Morton C. Tuttle, of Aberthaw Construction Co., and Charles R. Gow, of Charles R. Gow Co.

WASHINGTON SOCIETY OF ENGINEERS

The Washington Society of Engineers, at its meeting on November 16th, was addressed by Thomas Riggs, Jr., formerly governor of Alaska, on "The Problems of Alaska."

FOR TECHNICAL PAPERS

In accordance with a plan started in 1920 the Illinois Society of Engineers has offered five prizes of $25 for papers to be presented at the annual meeting at Decatur, Ill., January 24 to 26, 1922. There will be a prize for each of the following classes: (1) Drainage, (2) Roads and pavements, (3) Sewerage, (4) Surveying, (5) Miscellaneous civil and municipal engineering. This competition is limited to members of not more than five years standing and to candidates for election at the annual meeting. Papers must be submitted by January 1st and must be prepared in accordance with the rules and conditions. Full particulars may be obtained from E. E. R. Tratman, C. E. Secretary, Illinois Society of Engineers, Wheaton, Ill.

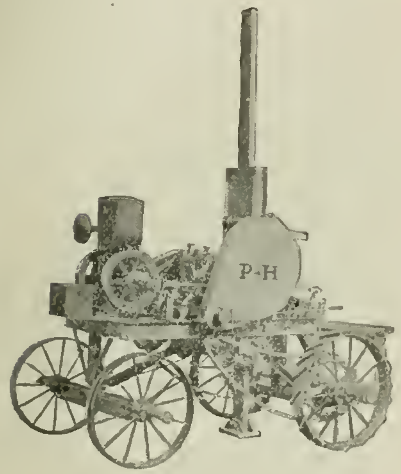
(*Continued on Page 424*)

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

NEW P & H POWER TAMPER

The accompanying illustration shows the latest model P & H Power Traction Tamper made by the Pawling & Harnischfeger Co., and having a number of improvements over the previous model. All chains and gears are supplied with enclosing guards, the tamper and steering cables used are ⅜-inch diameter instead of ¼-inch, new type traction wheels are furnished, with extension axles to allow for changing the tread from 58-inch to 76-inch. The standard tamping head is 150 pounds in weight as before.



POWER TRACTION TAMPER

Other refinements are embodied in the design which makes it an improved machine for speeding up the work of tamping all kinds of ditches and trenches. Only one man is required to operate it—control of the power ram and the forward or backward movement of the tamper being readily accomplished from the operator's seat.

CAST IRON PIPE FOR HOUSES SERVICES

The United States Cast Iron Pipe and Foundry Co., has issued a leaflet, "To Promote the Use of Cast Iron Pipe of Small Diameter for Waterworks Service in Houses."

It claims that cast iron pipe meets the 6 principal requirements for a good service pipe, namely, that it should not injuriously effect the water passing through it, that it should not impair the appearance, taste or odor of the water, that it should always have sufficient capacity, that it should be strong and durable, that it should be easily made, and that it should be inexpensive.

The company manufactures cast iron service pipe of a minimum diameter of 2 inches, ample for ordinary needs, especially as it is not as readily obstructed by interior accretions as are most other kinds of pipe. A special 2½-inch size is also manufactured for larger capacity if necessary, and all of the service pipe is covered with the standard water pipe coating accepted by the American Waterworks Association. The pipe is cast vertically, bell down, in 9-foot lengths, up to 3 inches in diameter above which it is cast in 12-foot lengths. Two-inch pipe is cast with weights of 8, 8½, 9 and 9.9 pounds per foot intended for service under corresponding pressure heads of 100, 150, 250, and 300 feet.

SMITH MIXERS

"On the Job with Smith Paving Mixers" is the title of a new Catalog (No. 409-B), issued by The T. L. Smith Company, 1125 32d Street, Milwaukee, Wis. Photographs taken on various jobs throughout the country of all sizes and types of Smith Paving Mixers, are featured, and also illustrate the various types of auxiliary equipment used by road contractors—industrial railway and batch boxes with paver derrick dump body trucks, automatic loaders, wheel barrow loading, etc.

Mechanical points of particular interest in Smith Pavers are shown by means of actual photos. Copies of this new catalog 409-B will be gladly sent free on request.

INDUSTRIAL NOTES

The Southern Power Co. is to build two new plants, the first an addition to the present plant at Great Falls, S. C., to be known as Great Falls Power House No. 2, and the second plant at a point twelve miles from Charlotte, N. C., to be known as the Mountain Island Station.

Payne Dean, Limited, 103 Park ave., New York City., manufacturer of Dean control for electrical operation of water, gas and high pressure steam valves, has established offices in Pittsburgh and Chicago, with C. J. Burrage in charge of the former and A. H. Kohibusch, in charge of the latter. The Pittsburgh office is in the Bessemer Bldg., and the Chicago office in the Lumber Exchange Bldg., 11 S. La Salle St.

The dedication exercises of the Arkansas Hydro-Electric Development Company, Dam No. 1, Little Red River, were held on Friday, November 4th, at Camp Livingston, White county. The dedication address was delivered by Governor T. C. McRae.

The Orton & Steinbrenner Co. of Chicago, manufactures locomotive cranes, clam shell and orange peel buckets, have made arrangements with the F. C. Richmond Machinery Co., 117 West Second St., Salt Lake City, Utah, to represent them.

The Koppel Industrial Car & Equipment Company who are large manufacturers of Industrial Cars, Narrow Gauge Track Materials, etc., have opened a new district office in the Railway Exchange Building, Kansas City, Mo. Harry C. Kraft, manager.

The Austin Machinery Corporation, Chicago, announces as its sales representatives for the general Illinois and Iowa-Mississippi territory the Gierke-Robinson Co., with offices at 615 Kahl Bldg., Davenport, Ia., opened November 1st. This company will handle a full line of Austin earth-removing road-building and concrete mixing equipment.

Cooley, Mortimer Elwyn, dean of the College of Engineering and Architecture of the University of Michigan, has been elected president of the American Engineering Council of the Federated American Engineering Societies.

MacCrae, Don, has been appointed consulting engineer for District 10, the Arkansas-Missouri Highway District and the Spring Lake District, Pulaski County, Ark.

The H. W. Clark Company announces an increase in its capital stock from $75,000.00 to $200,000.00 ($150,000 common and $50,000 seven per cent preferred cumulative).

RAPID TUNNELLING

The 11-foot 3-inch main tunnel of the Hetchy Hetchy Water System was, during the month of August, driven 776 feet through hard rock by F. P. Hickman working from the Priest Portal and operating 3 shifts per day. The area of the heading is 406 square feet, drilling was done by three Ingersoll Rand machines, the mucking by the Myers-Whaley machine. The schist and quartzite were blasted with 28.3 pounds of 40 percent gelatin powder per linear foot.

DRAGLINE EXCAVATOR ON PADS

For the digging of 510 miles of canals and laterals in the Worth Drainage district, Florida, there are used three Bucyrus Class 9½ steam operated caterpillar mounted dragline excavtors with 45-foot booms and 1½-yard buckets. These heavy machines are successfully moved over soft and swampy ground by the use of 6 x 34-foot pads, 9 inches thick, made of crossed layers of 3x10-inch planks. Bridles at both ends of each pad are hooked to the loading chains on the buckets and the pads are swung in position in front of the machine and dragged forward by the dragline as the machine advances. They are carried on logging carts hauled by the tractor for longer distances.

TRACTOR WORKING IN CLAY WITH A SNAP BAR ABOUT FIVE YARDS LONG

HIGHWAY BUILDING WITH REVERSIBLE TRAILERS

Highway construction in Arizona includes the use by the Pinal County Highway Commission at Florence, of seven 4-wheel 2½-ton reversible highway trailers, equipped with two ½-yard bottom dump spreader type bodies for handling road surfacing material from the storage bins to the required position.

Ordinarily they are hauled with ease by 2-ton trucks, but in some cases they are handled by a 75 h. p. Holt tractor, which is shown in the accompanying engraving as it was used to successfully handle the entire fleet of 7 trailers. A letter from W. W. Lane, Highway Engineer, states that the trailers have been found "entirely satisfactory in every way."

PERSONALS

Maier, Harry L., formerly engineer in charge of sewers, Street and Sewer Department, Wilmington, Del., has been appointed chief engineer to succeed Edgar M. Hoopes.

Barlow, J. E., formerly city manager of New London, Conn.

Powell, Trevor J., of Summit, N. J., has been appointed assistant county engineer of Union County, N. J.

Theriault, Adolph D., has been appointed superintendent of the Pennichuck Water Works, Nashua, N. H., to succeed William F. Sullivan.

Hicks, C. P., of Centralia, Wash., has been employed by the city council of Pe Ell, Wash., as engineer in charge of construction.

Sperr, Ray, county engineer of Keweenaw County, Mich., has resigned to accept a position with the Wisconsin State Highway Department.

Harsh, Robert S., of Alliance, Ohio, has been appointed state architect and engineer of Ohio and will be connected with the department of highways and public works.

Blunden, J. Paul, formerly county engineer of Boone County, W. Va., has been appointed assistant division engineer, West Virginia State Road Commission. Headquarters at Martinsburg.

NEWS OF THE SOCIETIES

(Continued from Page 422)

GOOD ROADS CONGRESS AND SHOW

The Twelfth American Good Roads Congress and Thirteenth National Good Roads Show to be held at the Coliseum in Chicago, January 17 to 20, is extending special invitations to women fully realizing that they are voters, tax payers and road users and when once interested in a patriotic movement are indefatigable in its behalf.

Numerous demonstration tests of road building machinery will be included in the exhibits at the show, with the machinery in actual operation. Reservations of exhibition space have broken all records, the entire lower floor of the Coliseum and Annex have already been engaged, necessitating the leasing of adjoining buildings in order to house overflow. The exposition will be the largest of its kind the world has seen.

Eight sessions of the Congress will be held. It is expected that at least 20,000 delegates will attend. One session will be devoted to a discussion of comparative designs in road pavements, another will be devoted to a discussion of the problems involved in highway traffic, especially truck transportation, safety on the roads and future laws and regulations governing highway transport. A third session will be devoted to taxation, bond issues and problems of highway administration and finance.

The Portland Cement Association, Chicago, Ill., the Asphalt Association, New York, the National Association of Paving Brick Manufacturers, Cleveland, Ohio, and other organizations of road material producers are cooperating in the arrangements for the Congress. One session, to be held under the auspices of the Portland Cement Association, will be devoted exclusively to a discussion of proper methods in building the various types of concrete roads. Another session, for which the program will be prepared by the Asphalt Association, will be devoted entirely to the construction of asphalt and other bituminous types of streets and roads, and a third will feature brick and other types of pavement. One session will be devoted exclusively to a discussion of the latest methods evolved in the construction of the common types of roads such as gravel, macadam and earth.

ATLANTIC DEEPER WATERWAYS ASSOCIATION

At the convention in Savannah, Nov. 18th, J. Hampton Moore, mayor of Philadelphia, was reelected president; Wilfred H. Schoff, of Philadelphia, secretary-treasurer; and Durrell Schuster, of Philadelphia, assistant secretary; George T. Leach was elected vice-president for North Carolina.

In the report of the committee on resolutions, which was adopted by the convention, the following resolution was embodied:

"The continued agitation for the canalization of the St. Lawrence river prompts us to reiterate our earnest belief in the principal declared at our convention in 1920, that all appropriations made by the congress of the United States for the improvement of waterways should be expended solely upon such improvements as lie wholly within American boundaries, jurisdiction and control."

Southern delegates expressed considerable dissatisfaction over this resolution and prophesized that it would have the effect of antagonizing the whole west and southwest, with result that appropriations for intercoastal waterways would be held up.

The southern delegates were defeated in an effort to have the resolutions committee embody in its report a resolution asking congress to appropriate $14,000,000 for the construction of the Inter-coastal waterway from Beaufort to Jacksonville, Florida. The remainder of the resolutions committee report simply reaffirms the resolution approved last year at Atlantic City and asks only that congress adopt the inter-coastal waterway from Beaufort to Jacksonville.

OHIO VALLEY IMPROVEMENT ASSOCIATION

At the Pittsburgh convention, Nov. 17th, members and guests attended opening ceremonies of Boeline Dam, 14 miles below Evansville, which is the 35th of a total of 44 having an estimated total cost of $81,000,000.

The officers reelected were: President Oscar F. Barrett, Secretary W. C. Cutkins, Treasurer George Puchta, all of Cincinnati. Among the vice-presidents chosen were: William B. Rodgers, J. Frank Tilley and Thomas E. Doyle, all of Pittsburgh. The convention passed a resolution asking for the appropriation of $20,000,000 within the next five years to complete the improvement of the Ohio River from Pittsburgh to Cairo.

After the adjournment of the convention a conference was held and approved the calling of a general conference of all waterways organizations to be held at Washington late in January.

PUBLIC WORKS.

CITY COUNTY STATE

425

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 51 DECEMBER 3, 1921 No. 23

Municipal Street Cleaning in Philadelphia

This year about a quarter of the dirt, ashes and garbage collection and removal is being done by force account better and cheaper than the remainder is done by contract. Material hauled directly and by relay trucks from loading station. Skilled organization and abundant standardized equipment in service and ordered. Specialized labor, good wages and elimination of politics have reduced payrolls and turnover.

For the year *1921* Philadelphia has an appropriation of $5,400,000 for cleaning 1,800 miles of paved streets, exclusive of Fairmount Park, which include about 300 miles of macadam, 270 miles of brick, 900 miles of asphalt and about 300 miles of granite block. Within the city limits there is a population of about 1,850,000, an area of 129 square miles, and an assessed valuation of about two billion dollars of real property. The inhabitants are 60 percent native Americans and the city districts may be roughly classified as wholesale and retail merchandizing, light and heavy manufacturing, and residential, exclusive of public parks and the extended water front on the Delaware and Susquehanna rivers, largely devoted to shipping interests.

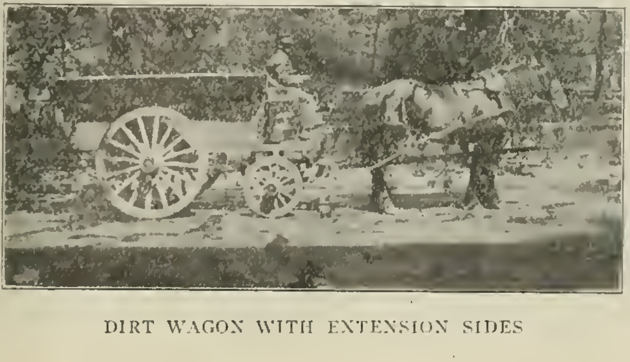
For about 40 years the city street cleaning has been done under separate contracts for collecting and removing street sweepings, ashes and garbage; most of the refuse, except the garbage, being dumped for fill in low outlying territories. The garbage has been destroyed by incineration.

PRELIMINARY MUNICIPAL ORGANIZATION AND OPERATION

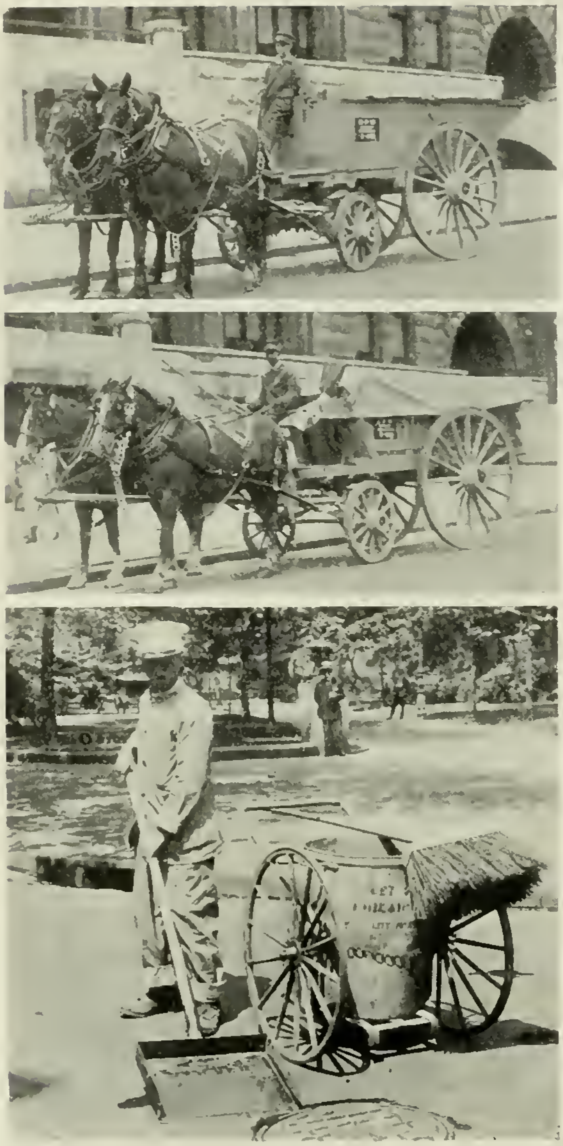
Last year a movement in favor of street cleaning by the municipal forces resulted in the recommendation by the Director of Public Works that two of the thirteen districts into which the city is divided should be cleaned by the city forces and equipment, and this plan was approved by the city council November 17, 1920.

It was impossible to provide sufficient equipment for the entire city by the first of January last, so the municipal work was restricted to two districts, 5 and 6, which include the retail business area and comprise about one quarter of the total area of the city. For this portion of the city there is available $1,250,000 for street cleaning, which has been

MOTOR FLUSHING TANK



DIRT WAGON WITH EXTENSION SIDES



STEEL ASH WAGON—GARBAGE WAGON WITH CANVAS COVER—ASPHALT BLOCK MAN AND EQUIPMENT

accomplished by the city forces within the appropriations and with results so much better than that in the remainder of the city that the contractors for the latter area have been stimulated to improve their service.

The municipal work has been divided into three divisions under charge of its superintendent. Most of the ashes and rubbish are delivered to one of two public dumps within the city limits, where there is a capacity for about 37,000,000 yards of material (enough to provide for many years) by filling an average depth of 38 feet up to the required street level. Plans are under way for three incinerators to provide for the destruction of all the garbage. It is estimated that the materials reclaimed from refuse will pay for the cost of destruction and that the fuel in the waste matter will provide for the incineration, but oil burners will be installed to supplement the garbage fuel if necessary. Construction of the incinerators is delayed by the failure of the Council to approve any of the locations for them that have been proposed.

At present all of the ashes and street sweepings collected by the municipal forces are hauled directly in the wagons by which they are collected to the nearest dumps, excepting in Division B, where a relay station is established and the sweepings and dirt collected by the wagons are transferred to large motor trucks and hauled several miles to the dump.

When the city commenced street cleaning in January 1920 they took over the almost complete organization of some contractors, making a total force of about 850 men, among which the turnover was at first 75 men every two weeks, or about 8.7 percent, a proportion which has been reduced to 5 men in two weeks, while the total force has been reduced to about 743, retaining about 50 percent of the original employees.

By a careful arrangement of schedules to provide fair working conditions, the complete elimination of politics, a payment of wages slightly above the prevailing rate, careful instruction and selection of men, specializing of work, and the operation of the civil service system which permits discharge for cause (including inefficiency and laziness) the efficiency of the department has been greatly increased and the men are contented and reliable. The labor appropriations for this department amount this year to $1,700,000, which at the present rate will suffice. For July the payroll was $83,000.

DIVISION D

Division D, in the residential part of the city, is 14 squares long by 17 squares wide and has a large percent of the streets paved with asphalt. The street cleaning is done by five regular 9-man gangs, which sweep all of the streets daily. The ashes and rubbish are collected from each house once a week, the districts being divided into six parts, one of which is visited each successive day.

The asphalt streets are sprinkled two squares in advance of a pair of machine sweepers with brooms 8 feet long that proceed in battery formation, sweeping the dirt into windrows alongside both curbs. In each cleaning gang there are men that sweep the windrows into piles that are loaded by one man and helper on a cart following along each side of the street. There is also an inlet man with a rake having a handle 12 feet long, one alley man and the foreman. The motor-driven sprinkling machines have 1,500-gallon tanks with a capacity for sprinkling five blocks.

There are on this division 27 day gangs cleaning asphalt streets. Each gang has one block man with a 2-wheel pushcart carrying a steel can 19 inches in diameter and 24 inches deep, a fiber broom and a handled pan, with which droppings, rubbish, dirt, leaves, etc. are collected at the rate of about 5,000 square yards per day per man in the district, which is composed of about 40 percent residences and 60 percent tenements.

RELAY STATION

The dirt, refuse and ashes collected from Division D are hauled by teams to the station at 1120 Race street that has been established in a two-story 200 x 150-foot brick building. The lower story contains stables for 112 horses, smith shop and harness room.

The upper story is used for storage and for the delivery platform to nine 6 x 10-foot hoppers set in the floor across one end of the building.

The carts are hauled up a ramp to the second floor by an electric hoisting engine, driven around to the opposite side of the building and are backed up against a stop log and dumped into the hoppers. Five-ton motor trucks are driven from Race street across the block through an alley or driveway, passing the lower story of the building underneath the hoppers, where the trucks stop to receive their load. On signal from the driver the dump man on the upper floor pulls a cord that unlocks the bottom flaps of the hopper, which discharges its contents into the 5-ton truck, which has elevated side boards giving it a capacity of 10 or 12 yards. The trucks are loaded and passed on in about 15 seconds. They haul their loads 3½ miles to the dump in a swamp, where three attendants direct and assist in the unloading. In winter the work for the 238 blocks included in this division is handled by 20 trucks and 30 collecting wagons that haul from 100 to 250 loads a day to the dump. In the business section of the city the streets are cleaned at night during seven months of the year.

The relay station houses 55 ash and dirt wagons, 12 machine brooms, five 4-yard steel-body ash wagons, 50 wooden Philadelphia type 2-ton dump wagons, with extension sides with a capacity to 6 yards, 5 sprinkling wagons, 12 machine sweepers (part of them of the Campbell make), and 27 asphalt cleaning equipments, each consisting of a push cart, 4 cans, broom and pan as already described.

The force employed in the relay station or working from it as a headquarters include four men on the dump floor, two men to pull the hauling cable down the ramp, one man to operate the cable hoist, two men on the street tying canvas covers over the loaded motor trucks and making them ready, fifty drivers, four stable men, five 9-man gangs of street cleaners. five dirt helpers, twenty-seven block men, two flush cart drivers, and two helpers and one sub-foreman with each street cleaning gang, one sub-foreman for the twenty-seven block men, one sub-foreman for flushing, one checker-out, one inspector who attends to complaints, one stable boss, two night stable men, one ash foreman and one helper, one street cleaning foreman, three horse shoers, one harness man and the superintendent.

Mules are used for drawing the machine brooms and horses are used in all other teams. All of the stalls are double, but a few of them are divided by a skeleton partition, consisting of a longitudinal plank suspended about 3 feet above the floor.

STREET CLEANING GANG WITH MACHINE BROOMS

HOSE FLUSHING GANG

Every horse and mule has an identifying serial number burnt on his hoof and is carefully inspected every time that he comes in from work and is shod or loose shoes tightened at night. Each horse receives 10 quarts of oats and from 17 to 20 pounds of hay twice a day, the oats being fed at six or seven o'clock P. M. and at four A. M., and the horses being watered at nine P. M., and three times during the day. Each horse is provided with a canvas blanket for winter and a stable blanket faced with burlap outside.

The harness for each team is suspended from the ceiling by ropes and pulleys similar to the system used in fire engine houses, and is dropped on the horse's neck, the fastenings snapped together so that the horses are ready to be hitched to the wagon in a few seconds. All of the equipment in the stable is thoroughly washed once a week.

The city provides rubber hats, coats and boots for the street cleaners, black for the drivers and helpers and yellow for the block men.

In the summer the street cleaners work from 5 A. M. until 1 P. M. and the ash men work from 6 A. M. until their work is completed and from 5 o'clock until 9 o'clock P. M. for a uniform wage of $27 per week.

DIVISIONS A AND C

Street cleaning division A, which includes the district around the city hall, is 27 blocks long and 9 blocks wide, and division C, which is mostly residential, is 14 blocks long and 14 blocks wide. In both of them the organization and operations are similar to those for division D, except that divisions A and C have each of them only four cleaning gangs. In division A about one-half of the work is done during the daytime by the broom men and the other one-half by the machine sweepers at night. In the summer time the day workers collect about 24 wagon loads of dirt and the night forces about 22 3-ton truck loads. The average total collection in the summer is about 50 to 60 wagon loads of dirt and rubbish and in the winter from 150 to 180 loads.

The equipment at the station for this division includes 69 horses, 20 mules, 12 machine brooms each drawn by two mules, 10 4-yard steel 2-ton dirt wagons, 50 Miller and Philadelphia 4-yard wooden rubbish and ash wagons, 11 3-ton Mack trucks for ash collecting and night dirt collecting, 200 hand brooms, one dozen machine brooms, and 150 shovels.

The average force consists of 100 block men, six 10-men street gangs, six inlet men, four flushers, one 8-man hose gang, eight stable men, two night watchmen, four wheelwrights, two horse shoers, two wagon blacksmiths, two helpers, one street cleaning inspector, one stable foreman, one street cleaning foreman, one dump man, eight sub-foremen, one general foreman and one superintendent. The equipment and forces for division C are similar to those of division A.

PROPOSED DEVELOPMENTS

In addition to the equipment already enumerated, the city is purchasing a large amount for cleaning the remaining eleven districts for which the cleaning contracts will expire January 1st. Among proposals already received are those for 35 5-ton trucks, 20 motor flushers, 30 motor-driven ash trucks, besides tractors, snow plows and motor-driven street sweepers and 300 horses. It is proposed to establish three transfer stations, where the ashes may be transferred from collecting wagons to motor trucks in which they will be hauled a distance to be dumped. These will be located at the same points where the incinerators are to be established.

The collection and incineration of garbage and rubbish would be more rapid and less costly and the city would present a much better appearance if the efforts of the street cleaning department were more generally and efficiently seconded by the citizens themselves. Although they are required by law to place garbage in water-tight closed metal containers they are often inclined to wrap it up loosely in paper and throw it in the alley, there to be disintegrated, scattered and decomposed rapidly, making it difficult to collect and breeding flies and foul odors, besides presenting a very unwholesome appearance.

The education of these people to conform to the law and observe sanitary methods is slow and troublesome, but it is somewhat accelerated by police cooperation that resulted, last year, in about 500 arrests, mostly of foreign born citizens, for violating the sanitary regulations, for which, on conviction, they have to pay fines and costs, amounting to usually $14 or $24 each—punishment which has a more salutary effect than a long campaign of persuasion.

Preliminary Announcement of Highway Work

Under date of November 19th the division of highways of Massachusetts issued a circular to contractors relative to highway construction proposed for 1922, with the object of permitting contractors to make preliminary investigations of the work sufficiently in advance of the requests for bids. This plan was inaugurated by the Massachusetts Department of Public Works a year ago and it believes that to this move can be credited a portion of the satisfactory results secured in carrying on the work of 1921, which is now practically completed.

Such progress has been made by the department, in planning the 1922 work that many projects are practically decided upon and the plans had been sufficiently advanced to inform contractors relative to the engineering requirements. "It is desired that contractors who are interested in highway construction for this department in 1922 should immediately get in touch with the chief engineer, learn of projects definitely decided upon, be advised as to location and amount of work proposed, and supplement such information by their own investigations at the different locations. This preliminary investigation is expected to place contractors in a position to submit intelligent bids early next spring and thus aid in securing an early start in construction work for the season."

Information given at this time is not guaranteed to be final but is subject to possible changes. As even the type of surface and character of construction may be changed, the commissioners suggest that contractors, in their investigations, should contemplate the different types of standard construction and surface that now prevail in the department, in order to be prepared for bidding upon any of the standard types of construction.

The Sanitary Condition of New York Harbor[*]

By Kenneth Allen[†]

During the past ten years there has been a steady depletion of dissolved oxygen in harbor waters and the situation is now grave

New York can discharge its sewage unpurified into adjacent water with much less danger of creating a nuisance than most cities, but the time is approaching when something on a larger scale than heretofore attempted must be done if certain areas of the city are not to pass through a period of discomfort and with unsanitary living conditions such as many cities have experienced to their sorrow.

The unusually thorough and extensive series of investigations of the New York Bay Pollution and Metropolitan Commissions placed the situation squarely before the public, and with the opinions of the experts called in by the latter commission and in connection with the suit of the State against the State of New Jersey and the Passaic Valley Sewer Commissioners, furnish ample ground for apprehension.

Such high authorities as Dr. J. Gilbert Fowler of Manchester and John D. Watson of Birmingham, England, Professors Olin H. Landreth, C. E. A. Winslow and W. P. Mason and Past-President Desmond FitzGerald of the Am. Soc. C. E. were particularly emphatic in their statements. In the opinion of Professor W. T. Sedgwick, "There will surely come a time when the comparatively innocuous fermentation which now goes on in these bodies of water in the presence of dissolved oxygen will, by absence of such oxygen, pass over the evil-smelling, unsightly, disgusting and dangerous putrefaction, with the result that what is now a comparatively decent and unobjectionable body of water will become a public nuisance and cry loudly for relief."

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[*] Paper before the American Society for Municipal Improvements.

[†] Sanitary Engineer, Board of Estimate and Apportionment, New York City.

Now these opinions were expressed about eight or ten years ago, and it may be interesting to compare conditions as they are today with those that obtained then.

Superficially, as evidenced by sight and smell, the difference in the situation in not marked. Along the slips, and especially in the Harlem and Lower East rivers, it is normally disgusting to those whose attention is directed to it; and at times, on warm damp summer evenings, a faint but characteristic sewage odor permeates the atmosphere along those streams. In cool weather, on the other hand, the only evidence of pollution is by vision, the water being cloudy at all times along the shores and carrying more or less scum with solids of sewage origin, both coarse and fine.

In the early investigations of the Metropolitan Sewerage Commission various tests of the harbor water were made, in which those for the ammonias, nitrates and nitrites as well as for bacteria were prominent, in accordance with current practice. But beginning in 1909 emphasis was laid on the test for dissolved oxygen, now generally recognized as the most illuminating of all tests for the pollution of water. These determinations were kept up until the termination of the Commission's work in 1914 and have since then been continued by the Board of Estimate and Apportionment, under the direction of the chief engineers, Nelson P. Lewis and Arthur S. Tuttle.

As is well known, clean river or ocean water is usually nearly saturated with dissolved oxygen absorbed, for the most part, from the air. On mixture with polluting organic matter, such as sewage, the contained bacteria use up this oxygen in their life processes with an avidity dependent upon their concentration (degree of pollution) and the temperature. Owing to their dormant condition in winter, there is little draft on the oxygen, which remains high in the main channels in spite of a relatively intense pollution; but in the summer their effect is readily recognized as a function of the pollution.

For this reason it has seemed undesirable to attach great importance to other than warm weather tests, and for practical reasons these have been limited in this discussion to the four months following the first of June. The averages for the several main branches of the harbor as determined up to 1921 are given in the following table.

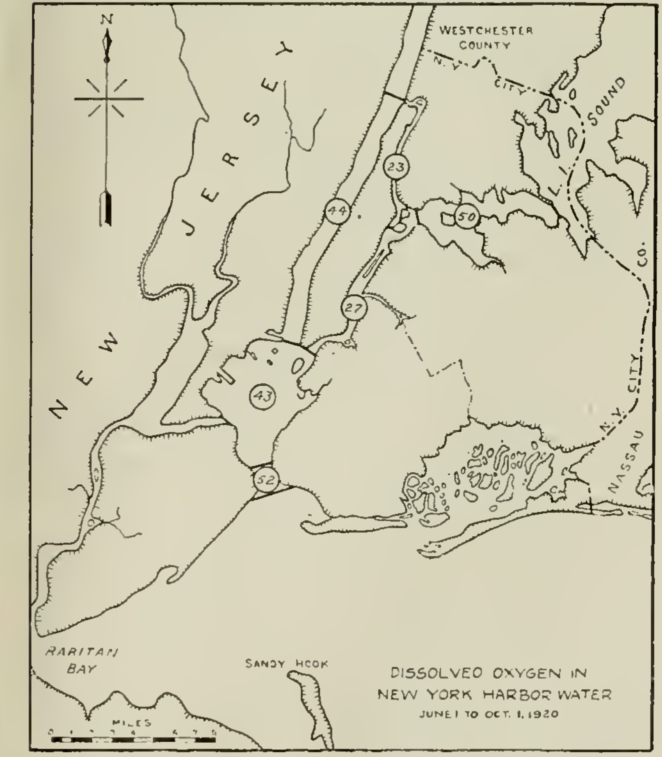
Average Percent Saturation with Dissolved Oxygen of the Water in the Main Branches of New York Harbor

Year	Samples No.	Hudson below Spuyten D.	Harlem River	Upper East R.	Lower East R.	Upper Bay	Kill van Kull	Narrows
1900	404	72	55	86	65	67	70	83
1911	861	62	42	69	54	72	70	76
1912	150	58	..	..	49	64	65	71
1913	880	57	29	..	43	66	65	69
1914	477	50	30	50	40	71	..	68
1915	247	43	28	..	33	72	..	78
1916	176	46	24	..	26	64	..	63
1917	257	42	22	47	29	50	..	63
1918	60	54	23	50	21	56	..	61
1919	322	36	29	30	24	51	35	58
1920	294	44	23	50	27	43	42	52

Although the depletion has not been uniform, the general impairment of the quality of the harbor water is quite apparent; and if it is recognized that when the degree of saturation remains less than 30% for several days in warm weather, local nuisances are probable, and that with sustained total depletion an intolerable condition would result, the gravity of the situation is obvious. For it is to be remembered that the above figures are averages and that there are times nearly every summer when certain stretches of the Harlem river are entirely devoid of dissolved oxygen and when the saturation in parts of the Lower East river lies between 5 and 15 percent.

For several years prior to the dissolution of the Metropolitan Sewerage Commission in 1914, a number of influences served to focus attention on the matter of relief of the pollution of the harbor. Aside from the voluminous publications comprising the findings of the commission, there were the hearings in the Passaic Valley Sewer Case, decision on which by the U. S. Supreme Court has recently been handed down and in which many of the most eminent American sanitarians testified. Then there was a study of the subject by Col. W. M. Black and Prof. Earle B. Phelps and, later, the establishment, under the Board of Estimate, of the New York Sewer Plan Commission followed by the Bureau of Sewer Plan. These were all instrumental in attracting attention to the subject.

For the past few years there has been little or no agitation in furtherance of improved sewerage, but the value of earlier investigations has been conserved and studies for the collection and treatment of sewage extended by the Board of Estimate and Apportionment in such a way as to conform to the development of the city and to improvements in methods of sewage treatment.



DISSOLVED OXYGEN IN NEW YORK HARBOR WATER

In addition to this a number of projects for the interception or treatment of sewage have been officially adopted which, if not already carried out, will be put under contract at an early date. Among these are the fine-screening plant at Dyckman street and the reconstruction of sewers in the Clarkson street district, with interception to a fine-screening plant at Canal street, Manhattan; the construction of submerged oulets for Truxton street, Tiffany street, Farragut street, and Old Ferry Point sewers in The Bronx; the interception from a large area in northern Queens to an outlet off Theodore street; the sewerage of the Rockaways with an outlet off Beach 149th street, Queens; the establishment of a fine-screening plant at Paerdegat in Brooklyn, and the interception, with fine-screening and disinfection, of the sewage from a large area near Midland Beach and South Beach in the Borough of Richmond. All of these improvements have been in conformity with the general plan as developed in the office of the chief engineer of the Board of Estimate and Apportionment at the time of their adoption.

The earlier studies of the Metropolitan Commission comprised the entire Metropolitan area lying within 20 miles of the New York City Hall, covering 700 sq. mi.—a perfectly justifiable proposition, since the pollution of the harbor is derived from the whole of this larger area. But failure to secure the co-operation of the New Jersey authorities led to the restriction of their plans to New York. The outstanding features of these plans were as follows:

(1) The disposal of a large volume of sewage tributary to the Harlem river and from neighboring territory in Manhattan and The Bronx or Wards Island by sedimentation.

(2) The transfer of another large volume tributary to the Lower East river and the North shore of Jamaica bay to an artificial island about 3 miles south of Coney Island where, after tank treatment, it would be discharged into the lower bay; and

(3) The collection of sewage from the remaining territory in all boroughs to selected points, where it would be treated—usually by fine screening or sedimentation.

Owing to a strong opposition to some of these features which developed at the time, the New York Sewer Plan Commission proposed as an alternative:

(1) The diversion by tunnel of the sewage tributary to the Harlem river to a point in the Hudson off West 155th street;

(2) The substitution of an artificial island off Red Hook—just south of Governors Island in the Upper Bay—for the more remote outlet in the lower bay off Coney Island, except that the sewage would all be taken from the East side of the river.

(3) Local plants to provide for the balance of the city's sewage, as in the former plan.

These modifications were all feasible and that relating to the Harlem river was approved by the Bureau of Sewer Plan in 1915, with treatment by fine-screening and a submerged outlet in the Hudson nearly a half mile from shore. With a discharge forecast at over 100,000,000 gallons per day at this one point it is quite possible that some further treatment should be anticipated during periods of extreme drought.

Plans for the disposal of the sewage from that part of Brooklyn fronting on the East river have remained in abeyance, although this, to a considerable extent, controls the plan for the rest of the Lower East river and the upper bay.

The "Ocean Island" project of the Metropolitan Commission was objected to on account of the high first cost made necessary by the construction of a large tunnel, some 12 miles long, to the point of disposal before starting operation. On the other hand, a discharge to the upper bay, in order to produce an equivalent result, would involve a higher degree of purification for the sewage, would in any case increase the local pollution, near the outlet, close to the main ship channel, and furthermore, it has been questioned whether the Federal authorities would consent to the construction of a new island on what is now an important anchorage ground. Such an island has, nevertheless, been recently proposed in the interests of commerce.

It is suggested, however, that a way out of this dilemma may be found in the following plan:

There will be tributary to Wards Island from the three neighboring boroughs an estimated volume of 142 million gallons of sewage per day by 1960. It has heretofore been the plan to treat this by plain sedimentation and to employ this method at the several plants to be established along the shores of the Lower East river. By this means but one-third of the putrescible matter would be removed, while it would be very difficult to find sufficient area for the local plants.

It is believed that experience with the activated sludge process has reached the stage when it may be said to be established as a standard method of treatment and one that produces a very superior quality of effluent. It is true that the question of dewatering the surplus sludge has not been fully solved and that the sludge from some sewages is much more amenable to treatment than that from others. Careful preliminary tests of activation and dewatering would therefore be necessary before any final commitment to this scheme; but it may be pointed out that the activated sludge process has already been or is about to be used at Worcester, Manchester and Reading in England and Milwaukee, Houston and the Chicago Sanitary District in this country, besides a number of smaller towns.

Now, if an activated sludge plant were substituted for plain sedimentation at Wards Island the well-oxygenated effluent would be such that in all probability:

a. Local treatment could be substituted for interception either to the lower bay or to an island in the upper bay.

b. Fine screening could be substituted for sedimentation at those local plants along the Lower East river where land for tanks would be difficult to secure.

The strategic advantages of Wards Island as a point of disposal are great. It lies close to three boroughs, two of which are densely populated in this vicinity, while the deep, turbulent waters of Hell

Gate offer ideal conditions for rapid diffusion and dilution of the effluent.

(A reproduction of a birdseye view showing the Wards Island location is given on the front cover of this issue.)

The dried sludge, rich in nitrogen, would appear to command a market as fertilizer which would go far toward offsetting the costs of operation. Unfortunuately charges for power in New York are high, so that the whole subject would require careful analysis from the financial standpoint. But the prospect of reaching a satisfactory solution for this very vexed problem would seem to be sufficiently promising to justify a careful investigation of this plan.

As indicated on the accompanying cut, there is a corner of Wards Island cut off from the rest by the N. Y. Connecting R. R., upon which a disposal plant could be most advantageously located. The land is vacant and of moderate elevation above tide level. No other such area is available in this vicinity. Although publicly owned, its value for other purposes in this central location is such that an increasing demand for its occupancy seems inevitable in the near future, and if it were thus made unavailable for purposes of sewage disposal the city would, in all probability, be obliged later to expend a greatly increased sum to provide facilities elsewhere.

To conclude, it may be said that the situation regarding harbor pollution has received careful and continuous attention for nearly twenty years; the main facts are known and recognized, and with the exception of the above problem relating to the lower East river, the general features of a plan for main drainage and sewage disposal for New York are pretty well defined. Progress in carrying out physical improvements was delayed here as elsewhere by the war, but what has been accomplished in recent years has been in line with the general plan, so that the city will not be called upon to abandon or reconstruct the work at a later date.

Detroit's Municipal Automobile Equipment

More than 550 trucks and passenger cars to have efficiency increased and maintenance reduced by construction of city garage. Special features developed, accurate records kept, and standards adopted

During the past six years the city of Detroit has used automobile cars and trucks in increasing numbers, and has kept up a systematic record of their performance, cost, durability and other principal data from which comparisons have been made, deductions drawn and the conditions analyzed for the determination of general requirements, developments of special features and the establishment of standards that have resulted in the adoption of two makes for all the light and heavy duty cars and trucks owned and operated by the city.

The motor transportation of the city is under the control of Werner Helmboldt, manager, under whose direction plans have been prepared for the construction of a three-story garage with 270,000 square feet of floor space for the storage and maintenance of the city vehicles now kept in seven different garages. The first floor will be devoted entirely to motor trucks, the second floor to passenger cars, tractors and motor cycles, and the third floor for repair shops and stock room with a machine shop, paint shop, battery and magneto shop and an experimental department. These advantages will eliminate duplication of accounting and other parts of the work and will keep the repairs strictly under supervision, make them in a uniform highclass manner, reduce the time lost in waiting and save the profits paid for outside services. It will also permit concentrating purchases of accessories, insure wholesale prices and the opportunity to buy large quantities on favorable markets.

Of the 238 motor trucks now operated by the city 87 are of the Packard make, which has now been adopted for all heavy hauling. Under the present system a number of important developments and convenient improvements have been made in the trucks for the different city departments.

For the water department service trucks of the size EF are equipped with caterpillar tires, weather proof cabs, vertical hoists and 5-yard dump bodies with double acting tail gates and two hooks front and rear. Four other trucks of the same size are equipped with bolsters for the transportation of pipe, and a size EC truck is equipped with a power takeoff, vertical capstan and a 15-inch stake and rack removable side body for handling surplus pipe left in construction jobs. With this truck two men will load a 24-inch pipe in one-third of the time formerly required by six men without the special truck. When not in duty on this service the capstan is protected by a shrouder hood and is used for supply and deliver duty.

In the asphalt division the fleet of 15 EF trucks with a 5-yard capacity keep the binder or asphalt in plastic condition for 6 hours as compared with a maximum of 2½ hours with the old type of equipment, and have displaced about 100 teams. At the present time the equipment is laying from 400,000 to 500,000 yards of asphalt per year with an average haul of about 5½ miles.

A truck equipped with a power driven key opens and closes large water gates in 48-inch mains in one-fifth of the time formerly required to do the same work with from 4 to 8 men instead of the 2 men required on the truck.

Four trucks with long wheel bases, 8-passenger cabs, and compartment bodies are used by the permit department for emergency in patch work. They carry a full crew of 8 men, tools and a miscellaneous load of bricks, cement, gravel and all other requisites for completing the job with one trip, and on heavy traffic streets it is estimated that the trucks have paid for themselves during the current year.

In the garbage department there are 5 size ED trucks with special 135-cubic foot welded-seam bodies, each of them doing as much work as could be accomplished by six horse drawn carts.

Specially equipped trucks are also used in various other departments of the city for fire and police service and for the lighting commission, one of the latter trucks having a power winch with a capacity of 10,000 pounds on a single line pull. More than 35 percent of the trucks now operated by the city are Packard trucks.

1922 Road Building in Michigan

It is planned to improve nearly 1,000 miles of road in Michigan next year, 300 of which is to be paved. It is estimated that the total expenditure will be $13,137,000, of which the state will pay $10,378,425. If, as is expected, an additional $2,250,000 is received from the federal government, the building program will be extended so as to approximate $15,000,000. Most of the work will be in the northern counties of the state, which so far have been comparatively neglected in the road building program.

Pittsburgh's Highland Reservoir No. 2

It will be remembered that last summer leaks in Highland reservoir No. 2, of the Pittsburgh water system, which has a capacity of 128,000,000 gallons, threatened the embankments and the water was quickly drawn from the reservoir and leaks in it located. The sections where these leaks were found were re-lined, the work being completed early in November at a cost of $50,000. Water was then pumped slowly into the reservoir which has a depth of about 33 feet. Before the water had reached a depth of 14 feet the engineers estimated that the leakage was as great as before the repairs were undertaken and that more than 2,000,000 gallons a day were escaping. It seems probable that it will be necessary to entirely re-line the reservoir at a cost which is estimated to be about $350,000.

Highway Appropriations in New York

We are advised by the state highway commission of New York that, although appropriations for 1922 will not be made until after the legislature meets in January, it is hoped and expected that they will immediately appropriate $5,000,000 to meet the federal appropriation. In addition to the $10,000,000 which will then be available, there is still left about $4,000,000 of the second $50,000,000 bond issue funds.

In addition to the above sum for construction work, the commission is preparing to submit to the legislature a maintenance program and will probably ask for at least $7,500,000 for this purpose, that being the sum appropriated for the calendar year of 1921.

More Than $76,000,000 for Highway Construction

Advices received up to a few days ago by Secretary Hoover from the governors of thirty of the states indicated that these states expect to undertake the construction of 6,261 miles of highways as a direct result of the recent passage of the federal highway act. This work will involve the expenditure of $76,400,000 and employ more than 150,000 workers.

This information was furnished in reply to a letter from Secretary Hoover asking each governor what amount of work his state could get under way within a period of 90 days after the passage of the act. Some of the larger figures are as follows: Texas—700 miles costing $8,000,000 and employing 13,500 workers, Georgia—360 miles costing $5,000,000 and employing 9,000 men. Indiana can use 5,800 men, Michigan 5,600, Ohio 5,300, North Carolina 5,000, Minnesota 4,350, and Louisiana, North Dakota, South Dakota and Mississippi 4,000 each.

In addition to the men directly engaged in road building there will be many others employed in quarries, cement mills, sand banks, asphalt plants, gravel pits and shops manufacturing road building materials and tools.

Many of the northern states have reported that weather conditions will not permit beginning road construction within 90 days, these including Connecticut, Maine, New Hampshire and Wisconsin. Others are unable at present to meet the federal appropriation with state funds.

Rapid Highway Concreting in Missouri

The Special Road District of Joplin made the record for concrete construction in Missouri in one day when Superintendent Hancock, with a gang of 22 and a Koehring Mixer, laid 520 feet of slab. This work was done under the supervision of John M. Malang, whose average has been 400 feet per day of 18-foot concrete pavement 8 inches thick in the center and 6 inches at the edge.

Mr. Malang is favored by two things in his road building operations. One is the fact that he is working in flat country over an old roadway surface and the other that he is using the "chats" in his mix. These chats are lying all along the job and it is not necessary to haul them more than 1,000 feet. They are easy to work in concrete and with a proportion of 1:1½:4 the concrete mixes well and takes on a fine finish. The mix is as dry as possible; the finisher follows close behind the mixer, and the little water that comes to the surface quickly evaporates.

With a crew of 22 men Mr. Malang has kept up a consistent record and now that James Hancock, formerly in the State Highway Department, has been placed in charge of the slab work, it is making great progress toward a finish.

Mr. Malang declares that he can build a similar highway in other parts of the state for $25,000 per mile, which is locally considered about the most reasonable piece of concrete work that could be done at the present time. It is at the rate of $5,000 per mile less than Illinois contracts have been let. The Governor of that state recently took great satisfaction in bringing down the price of concrete construction to $29,000 per mile. Here in the Joplin district under the supervision of Mr. Malang the pavement, eighteen feet in width is being constructed at a cost slightly exceeding $20,000.

The Kansas overseers were willing that the Joplin District should build a stretch for them. On a three-mile project in that state the Joplin men underbid the lowest by $67,000, or just about half the price. The road will connect the Missouri project out of Joplin.

PUBLIC WORKS

Published Weekly
at 243 W. 39th St., New York, N. Y.

S. W. HUME, President J. T. MORRIS, Treasurer

Subscription Rates
United States and Possessions, Mexico and Cuba $3.00 year
All other countries ....$4.00 year

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Western office: Monadnock Block, Chicago
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Pollution of New York Harbor.

If a bridge is designed for a certain load and the traffic crossing it continues to exceed the safe load by continually increasing amounts, the bridge will sometime break, in some part or as a whole. Meantime, to those using it there is nothing to indicate that the margin of safety is continually growing smaller, but the engineer can determine this by measurements and calculations.

There is similarly a limit to the amount of pollution that can be added to a given water without creating a nuisance. Until that limit is reached there is little to tell the senses of the approaching calamity; but once it has been passed, putrefaction with attendant unpleasant sights and odors will surely occur.

Apparently New York harbor is approaching close to that limit; in fact, parts of it now reach and pass it for occasional short periods. And nothing really effective has been done, nor plans adopted, to delay the day when the harbor's pollution will be unpleasantly apparent to all who travel over it or dwell on its shores.

In an article in this issue Kenneth Allen presents figures that demonstrate this approach of the danger point. Using the dissolved oxygen as a measure, it is shown that between 1909 and 1920 this had fallen from 83 per cent of saturation to 52 at the Narrows, from 67 to 43 in the upper bay, from 65 to 27 in the lower East river, and 55 to 23 in the Harlem river. Thirty per cent is considered about the danger point, and it is seen that both the Harlem and lower East rivers have passed that point, and the upper bay is not far behind. Considering how long it requires to construct works of the magnitude needed by New York, objectionable conditions can hardly be avoided unless actual work be begun at once on some plans for reducing the pollution.

Engineering Advantages in Municipal Consolidation

The citizens of Newark, which is really a metropolitan center of its own rather than a suburb of New York and one of the large cities of the country, are discussing the subject of the consolidation with that city of many of the surrounding communities which have been built up so solidly to their mutual boundaries that the entire area is in effect a continuous community.

While the matter of local pride probably actuates the Newark citizens toward consolidation and may influence those of the other communities against it, there are practical physical arguments in its favor. For instance, the topography is such that considerable confusion and difficulty is encountered in some cases in planning and constructing sewerage systems separately for the different communities. In fact, there are several instances of co-operation of adjoining communities in this district in the construction of joint sewers. Much difficulty and delay in these matters in the past could have been avoided by political consolidation, and undoubtedly such consolidation will have similar advantages in future construction.

Another advantage will be in connection with the water supplies. Some of the communities involved in the proposed consolidation are already suffering from a shortage of supply and uncertain as to where additional supply can be obtained. On the other hand, Newark and possibly one or two of the other communities have available, if not already developed, more water than they need. With consolidation, a re-distribution would undoubtedly be effected which would solve the problem for communities where it now exists.

Refuse disposal also can be considered as a joint problem and the location of disposal plants could be decided upon more economical grounds than at present, when each community indignantly refuses permission for the location within its area of plants of any kind for disposing of the refuse of adjoining communities.

In addition to the solving or rendering less difficult of these and other problems, the consolidation should permit of considerable increase in efficiency and reduction in operating expenses through elimination or unnecessary duplication of overhead, and the employment of higher grade officials for the operation of the public utilities than can be afforded by some of the smaller communities.

Reducing Number of Paving Brick Varieties

Manufacturers and engineers meet at the invitation of the Department of Commerce and reduce the varieties of paving brick from 66 to 11.

On November 15th there was held in Washington, D. C., a conference called by the United States Department of Commerce with a view to reducing the varieties of standard sizes and types of paving brick, which was called by Commissioner Hoover as the result of requests for his aid in the matter made by the National Paving Brick Manufacturers' Association. This conference decided upon immediate results along the desired lines and prepared a way for even further reduction.

The N. P. B. M. A. had compiled, by Secretary M. B. Greenough and with the aid of 44 of the largest manufacturers of paving brick, a list of the various sizes and types of brick that had been actually shipped by the manufacturers reporting between 1914 and 1921 inclusive. This tabulation showed 66 varieties of brick, which the conference agreed to reduce to 11, to be considered as standards.

Of these varieties, 8 were plain wire cut brick (vertical fibre lugless), 23 were repressed lug brick, 4 were vertical fibre lug brick, 7 were wire cut lug brick, a total of 42 varieties for regular use. In addition there were, known as special brick, 4 Hillside brick, Dunn wire-cut; 3 Hillside brick, repressed; 8 street railway brick, and 9 miscellaneous.

Not all of these 66 varieties were actually manufactured by the firms reporting in any one year, but in 1916 52 of them were in use, which number had been decreased to 46 in 1917 and to 36 in 1921; almost all of the reduction having been in the brick known as specials and in the repressed lug.

In reducing the number of standards, no combinations or compromises were introduced, but the reduction was obtained by elimination of those in less common use or apparently unnecessary. The committee felt that the present demands are such that there must be placed at the disposal of engineers brick having depths of either 3, 3½ and 4 inches, since the smaller cities want the first, the large cities require the 4 inch, while the state highway departments are demanding a 3½-inch brick. The committee considered it desirable to so reduce the number of sizes that all of them could be cut out of a clay column either 3 inches or 4 inches high, but the 3½-inch brick seemed to be necessary, for the present at least.

The committee also eliminated as standards all the various classifications of special brick except the Hillside type, which was deemed of sufficient importance to retain one size in the Dunn wire-cut and one in the repressed.

THE STANDARDS ADOPTED

With all the eliminations made, there are four standard sizes left as follows:

3½ x 4 x 8½
3 x 4 x 8½
3½ x 3½ x 8½
3½ x 3 x 8½

No one type of brick, however, will use all of these sizes. The plain wire-cut brick will be made in 3 x 4 x 8½ and 3½ x 4 x 8½. The repressed lug brick will be made in 3½ x 3½ x 8½ and 3½ x 4 x 8½. The vertical fibre lug will be made in 3 x 4 x 8½ and in 3½ x 4 x 8½. The Dunn wire-cut lug will be made in 3½ x 3 x 8½, in 3½ x 3½ x 8½, and in 3½ x 4 x 8½. The Hillside brick, both Dunn lug and repressed lug, will be made in 3½ x 4 x 8½.

In adopting these sizes as standard, the conference added the resolution that "The sizes stated in this report are to be regarded as nominal and subject to the usual variations of ⅛-inch in width and depth and ½-in in length.

The committee believed that further reduction of varities is desirable but that this should follow only after further study and after the idea of standardization has become well impressed on the paving field.

ATTENDANCE AT THE CONFERENCE

The conference was attended by representatives of the American Association of State Highway Officials, American Ceramic Society, American Electrical Railway Engineering Association, American Engineering Council, American Engineering Standards Committee, American Institute of Architects, American Institute of Mining and Metallurgical Engineers, American Society of Civil Engineers, American Society for Municipal Improvements, American Society for Testing Materials, Columbus Engineers' Club, Federated American Engineering Societies, Indiana Engineering Society, U. S. Chamber of Commerce, Western Society of Engineers, and the following U. S. departments: Bureau of Standards, Department of Agriculture, Department of Commerce, Department of the Interior, Navy Department and War Department. Six engineers attended as individuals and there were nine representatives of the paving industry.

After the address by Secretary Hoover, Mr. Greenough read the report of the N. P. B. M. A. giving the result of his canvass of the manufacturers showing the varieties that were produced by them, following which the chairman appointed for the actual work of elimination of varieties a committee comprising F. B. Dunn, Leon C. Herrick, P. H. Bates, O. W. Renkert and, as chairman, E. J. Mehre.

Following the adoption of the report, it was decided to appoint a committee of 10 to insure that the standardization embodied in the resolution of the conference is carried out, that constant contact between the various organizations and manufacturers represented at the conference and the Department of Commerce be continued, and to effect further eliminations in the remaining varieties when possible. This committee is to be composed of representatives from the American Society of Civil

Engineers, American Association of State Highway Officials, American Society for Municipal Improvements, American Society for Testing Materials, Federated American Engineering Societies, National Paving Brick Manufacturers' Association, Chamber of Commerce of the U. S. A., Bureau of Public Roads, Bureau of Standards and Department of Commerce.

In addressing the conference, Secretary Hoover said: "If the engineers who direct the work in our cities and the manufacturers will co-operate in reaching such a conclusion under the egis of the Department of Commerce, there can be no criticism of anybody engaged in this work; and if we can secure that co-operation we will secure at the same time progress in the industry itself, and not by any compulsion from the top, so that I look upon this meeting with more than usual interest because it is the first of those processes that we have brought to this stage." He referred to the difficulty of entering into trade agreements because of the possibility that they would violate some of the trade acts, and to the fact that the present administration of the Department of Commerce had felt that it could perform a service to manufacture if it acted as a center point about which their own co-operative action could take place.

FIGURES OF THE PAVING BRICK INDUSTRY

The report of the N. P. B. M. A. contained, in addition to the figures already given, very complete data concerning the entire brick industry during the past eight years. During each of the first three of these years the aggregate shipments of the companies reporting amounted to between 450,000,000 and 460,000,000 brick. Shipments fell off slightly in 1917 and in 1918 there was a sharp plunge to the lowest figure of the period, only 236,000,000 brick being shipped. In 1919 the shipments returned to 325,000,000, fell to about 300,000,000 in 1920, while figures up to the first of October, 1921, indicated figures higher than any year since 1917—approximately 375,000,000. This would indicate practically complete recovery of the short-haul markets, but the long-haul markets can hardly be expected to recover until freight rates decline.

Other tables showed the relative popularity of each type of brick during the past eight years. In 1914 repressed lug stood at the head, with Dunn wire-cut lug second, vertical fibre lug third, plain wire-cut fourth and all special bricks classed together stood fifth. The repressed lug held first place until 1919 when it took second, plain wire-cut (vertical fibre lugless) taking first place in 1920 and 1921. Dunn ,wire-cut lugu held second place until 1919 when it took first place, but dropped to third place in 1920 and 1921. Vertical fibre lug brick occupied third place until 1918 and fourth place since then. All the special brick classed together have remained at fifth place throughout, exceeding 1.9% only in the year 1917, when they totaled 2.3%.

The actual percentages indicate even more strikingly the change in popularity of certain of these classes. Repressed lug brick in 1914 was sold to the extent of 71.6% of the entire output of all types, whereas in 1921 it had fallen to 25.4%. Plain wire-cut brick meantime had increased from 5.9% in 1914 to 42.8% in 1921. Dunn wire-cut lug brick was a minimum in 1914 with 14.7%, reached a maximum in 1917 with 34.3% and in 1921 had fallen to 20.2%. The only type which has changed consistently and continuously throughout the period is the repressed lug brick, the use of which has been less each year than the year previous for the eight years recorded.

How to Select, Install and Operate a Concrete Mixer[*]

Charging the mixer; time schedule; accurate proportioning; removal of mixed concrete; highway concreting; care of machines.

CHARGING THE MIXER

Large mixers are generally permanently established, at least during the duration of the job, on a concrete or heavy timber foundation and receive the cement and aggregate through the fixed charging hopper into which the materials are delivered by batch boxes or, preferably, by gravity through chutes from storage bins. The cement being sometimes added in the same manner or emptied by hand from bags into the charging hopper on top of the aggregate.

Smaller machines are generally equipped either with a loading platform or a power loader. The price of the machine with the loader equipment used to be 35 or 40 percent less than that with the power loader. While the use of the power loader on the other hand increases the output of the machine from 20 to 30 percent and may generally be considered more efficient and economical than the platform loader for an output of 50 yards or more daily. Either type of machine can be served by wheelbarrows, hand carts, trucks, batch boxes, or by batch boxes or buckets handled by a derrick or other hoisting apparatus. The use of the platform makes more handwork and increases the probability of lost time and obstruction that is expensive and reduces the output of the machine.

When the power loader is used the aggregate is dumped into it from the ground level and there is plenty of space for its delivery and the removal of the empty containers without delaying the work.

The importance in having the machines so arranged as to maintain a constant operation is very great and is greater the larger the proportion of hand work involved or of expensive equipment used for serving it. The probability of lost time, delay and obstruction for a small machine is much less than for a large one.

TIME SCHEDULE

For instance, a 1-bag machine will require about 5 wheelbarrows loads of cement, sand and broken stone for each charge and if this is wheeled to the loading platform to make delivery it will take at least 35 seconds, which, plus a minimum net mixing time of 30 seconds and 10 seconds for discharge makes a total of 75 seconds minimum for 7 cubic feet of concrete. If the same machine has a power loader it may be filled and elevated while the concrete is being mixed thus cutting the time nearly 50 percent and almost doubling the output of the machine. With larger machines the advantage of the power loading is still greater because there is more danger of obstruction of the hand loading.

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[*]Continued from page 420.

WHEELBARROW CHARGING

When the mixer is charged by wheelbarrows great care should be taken to arrange the relative position of the different materials, the mixer, and the finished concrete delivery, so that no operation will obstruct any other operaion and that all of them may go on in a regular continuous cycle. Each man should be trained to perform a single duty with the fewest possible motions and to keep in time with the rest, and if any part of the work is excepionally severe the men should take turns in performing it for a short time and then be succeeded by other men, and so on. A competent foreman should be constantly in attendance watching all the operations and providing an immediate remedy, if there is any sign of congestion, or delay and replacing a clumsy or inefficient man or a broken wheelbarrow without delay.

The most advantageous arrangement is to have the sand and broken stone supplies on opposite sides of the mixer and at a slight elevation above the charging platform and to establish a loop connecting them and the machine, allowing the sand and gravel and stone to be taken alternately to the machine, dumped and the wheelbarrow passed on to the other storage pile, reload and come back and so on, thus making no empty trips, and never turning around or delaying at the machine. If this is impracticable the wheelbarrows should pass continuously over the platform, leaving it on the opposite side to their entrance and not obstructing by turning around or passing.

CAPACITY

When properly installed and operated a mixer of ½-yard capacity is generally ample for mixing 1,000 yards of concrete or for an output of 150 yards or less for each 8-hour shift. For special cases or very large work the number or size of the machines or both should be increased. Great care should always be taken to arrange for the maximum efficiency of the machine by removing the concrete as rapidly as it is mixed.

For large quantities of concrete it usually pays to provide elevated storage so that the mixer can be charged by gravity, an operation which only takes a few seconds and enables the machine to be run at a maximum speed of nearly or quite one batch per minute.

ACCURATE PROPORTIONING

It is of great importance that the proportion of aggregate and cement and water should be correct and that the mixing should be thorough and sufficiently continued, but unduly prolonging it is of no material advantage. These features are usually looked after by the engineer or his inspector, who should be earnestly and conscientiously supplemented by the contractor and his foreman, who will never derive any ultimate profit by attempts to skin the mixture, to curtail the time of mixing, to make it too wet or in case of cost-plus work to add too great proportion of cement.

If the job is one in which the contractor is responsible for proportions and qualities he should take special pains to secure uniform and properly graded aggregate and, if necessary, to mix it in order to get maximum density of output, which may require changing the mixture from time to time if the quality of his materials varies. The amount of water required is also likely to vary with differences in the aggregate and even with weather conditions and should be carefully watched and regulated.

AUTOMATIC DEVICES

The water should be admitted to the mixer through some sort of automatic device of which many are manufactured and others can be easily installed by the contractor with home-made appliances. The principal requirements are to have tanks that can be filled with accuracy to any given measurement while the concrete is being mixed and can be very rapidly discharged when the aggregate is placed in the mixer. The filling of the water tanks can be easily accomplished by an ordinary float valve, ball cock or overflow, and the water can be discharged into the mixer either by tilting mechanism or generally by any kind of a quick opening valve.

In order to secure a prescribed amount of mixing there has been placed on the market a mixer meter, which, when attached to the driving gear of the machine and properly adjusted and sealed, counts the number of revolutions of the drum and locks the gear so that the drum cannot be stopped or the concrete discharged until after the prescribed number of revolutions have been made, notice of which is given by a gong or other signal. These meters are available on the market, and an ingenous contractor or his mechanic can easily prepare a homemade device that will register the number of turns or will at least sound the alarm after a certain number of revolutions have been made. Such an apparatus is well worth while, both for the engineer and the contractor. Various more or less obvious devices besides boxes, have been successfully used for rapid and even automatic measurement of sand, stone and cement. Usually they are arranged in connection with delivery by gravity from hopper to mixer. A simple and effective one is substantially two horizontal sliding gates set far enough apart in a vertical chute to enclose between them the required volume for one batch and both are connected to the same operating lever that one is always open when the other is closed.

REMOVAL OF THE MIXED CONCRETE

All of the pains taken to select, install and operate the mixer will be of little avail if arrangements are not made for removing the concrete as rapidly as it is needed or as it can be delivered by the machine. This is done most positively and continuously when the machine can be placed at such an elevation that it delivers directly into a chute through which it is spouted to the required position, the lower part of the chute or if necessary all of it being moveable so as to distribute the concrete as required. This is often available in pit, trench and foundation work, in sewer work and the like. For work above ground level approximately similar results can be obtained by the use of a hoisting tower and spouting by which the concrete can be lifted to a miximum height of 200 or 300 feet and delivered to any point within a radius as large or larger than the elevation above the point of delivery.

Large quantities of concrete can also be handled by delivering it directly from the mixer to side or end dump cars on an industrial track high enough to enable them to dump directly into the forms and arranged so as to return on a loop and always have an empty car ready to receive the concrete as soon as a loaded car is moved away.

If circumstances do not permit the cars to place the concrete in the forms, flat cars may be used carrying 1, 2, 3 or 4 buckets, and the latter may be removed from the cars and swung to position and dumped as required by derricks, cableways, locomotive cranes or their equivalent. The mixer may also be served, as is often the case on smaller jobs, directly by the same derrick that handles the concrete buckets to position returns them and often, at intervals, is able to fill the charging bin or handle aggregate directly to the charging hopper providing the amount of concrete is comparatively small, so that one derrick can even unload cars, reclaim from storage, fill overhead bin and directly supply the mixer.

Ordinarily, however, if the job is of considerable size a special derrick with clam shell buckets required for unloading cars, loading the service bin or handling direct to the charging hopper, and another derrick will be kept busy handling the buckets of concrete. A cableway may also be arranged to handle either aggregate or concrete, or both.

BELT CONVEYORS

For very large and important pieces of work belt conveyors are sometimes frequently installed to handle the aggregate during the unloading, storage and reloading processes and to deliver it to the service hopper. They, of course, require to be loaded at the initial point and have a tremendous capacity when kept continuously in operation at full speed, but are costly to install and are not as flexible as a railroad or derrick system. Belt conveyors have also been used on rare occasions for delivering concrete from the mixer to the forms. Their capacity is almost unlimited, but they are not available for as many other purposes as are derricks and industrial tracks and cars.

Concrete should not be delivered in large quantities or to great distances by wheelbarrows and carts or trucks, which are meant for very small work or under special conditions or in case conditions warrant the establishment of a central storage and mixing plant from which concrete can be distributed to constantly shifting points at a considerable distance by motor trucks. In this case special pains must be taken to insure the prompt delivery of the concrete and to see that it does not suffer segregation from the vibration and shaking in transportation. This method has been used for highway construction in the city of Philadelphia and in some of the western states but opinions are divided as to the satisfactory nature of its results, some engineers highly recommending it and others objecting to it.

HIGHWAY CONCRETING

The use of concrete for the use of foundations and for the wearing surface of city and town pavements and state highways as well, has, in a very few years become widespread and important; many hundreds of miles of such work have been constructed and thousands more are to be built as fast as possible, and hundreds of millions of dollars are at this time available for such work that is strongly urged to give relief to unemployment and stimulate general construction.

It is entirely possible to accomplish this work with ordinary concrete mixing machines, but much better economy and greater rapidity is attained by the use of special paving machines that have been very rapidly developed for this purpose and are large, self contained locomotive machines of high efficiency. They are now to be had mounted on traction wheels or caterpillar traction so as to move over the subgrade from place to place under their own power and are provided with power loaders operated by the mixer engine, and with a distributing boom or chute and traveling bucket that deposit the concrete approximately in position as the machine advances. These machines are provided with small derrick booms competent to unload batch boxes and deposit them in the elevating hopper with which the drum is charged the moment the mixed concrete is delivered to the bucket. One of the machines properly handled will build several miles of 18-foot highway in one season and when worked to its capacity is a very satisfactory investment for the contractor, especially if he has many miles of road to build, a condition that is more and more favored by the authorities letting the work.

CARE OF THE MACHINE

A concrete mixer is usually subjected to about the most severe service of any kind of contractors' plant, and most of the standard makes are so sturdy that with occasional cleaning and faithful oiling they endure for months or even years, with very little repairs. Occasionally a gear may break or the ring on which the drum is supported may become worn or injured, but it is only necessary to keep new parts in reserve and carefully follow the maker's simple instructions to maintain the machine in good working order with little or no expense. Care should always be taken to wash the machine thoroughly at the close of work for the day to prevent any of the concrete from setting in the drum and to keep the exterior of the machine and buckets and chute thoroughly clean at all times when not in service.

Sometimes difficulty is experienced with the machine slopping or it may not always discharge rapidly and completely, but these troubles are likely to be due to the consistency or proportion of the concrete or to the speed of operation, and can generally be quickly remedied by intelligent adjustment or, at the worst, by appealing to the manufacturer, who is always ready to prescribe for a sick machine or to instruct the contractor or his forces in the case and operations so as to secure the best results.

Given enough work to do and reasonable care and intelligence in selecting, installing and opreating the machine so that there is a minimum of waste of time, labor and material, a concrete mixer can hardly fail to be as profitable and satisfactory as it is indispensible to a general contractor.

Retained Percentages on Contracts

In a brief paper before the American Society for Municipal Improvement, E. S. Rankin, engineer of sewers of Newark, N. J., presented some figures, which had been obtained for him through the "Clearing House" of the society, showing the percentages retained on contracts by different cities.

On sewer contracts in Newark a deduction of 20 per cent is made on all monthly estimates and in addition 5 per cent of the final estimate is retained for one year and 3 per cent for two years. Mr. Rankin thought these percentages were excessive, entailing a hardship on the contractor and an additional expense to the city by means of increased bids. In illustration he takes the case of a sewer constructed last year on which the contract price was $117,687.50. The cost of a bond, at 1½ per cent of the price bid, was $1,765.30. The interest on retained percentages on the monthly estimates was $405.64 and that on the final estimate was $575.36, a total interest on the retained amount of $981. This added to the cost of the bond gives $2,746.30, or about 2.3 per cent of the bid price.

Information was obtained as to the practice of 44 different cities. Thirteen of these reported that they retained 10 per cent on current estimates, 17 retained 15 per cent, 13 retained 20 per cent and one retained 25 per cent. Eighteen retained nothing on final estimates, 4 have no fixed rule and the others vary so greatly in both amount and time of retention that a brief summary of them is impossible, the amounts running from 3 to 20 per cent and the time from 30 days to two years.

The variations in retained percentage seem to be entirely independent of geographical location. On current estimates, Minneapolis retains 10 per cent and St. Paul, a few miles away, retains 15 per cent; Mercer county, N. J., retains 10 per cent, Atlantic City, N. J., 15 per cent, Bloomfield and Newark, N. J., 20 per cent; Allentown, Pa., retains 10 per cent and Oil City, Pa., 20 per cent.

Wells for Road Drainage

In the southeastern part of Missouri the country is almost absolutely flat, the highest land being a so-called ridge about 10 feet higher than the general level, on which is located a part of the "King's Highway." In constructing this highway there was no way apparent for carrying off the surface water, to say nothing of the subsurface water, by ordinary methods and the use of wells on both sides of the road was adopted.

These wells are built of 36-inch vitrified pipe, sunk vertically in the ground to a depth varying from 17 to 20 feet. At that depth a coarse sand is found which receives and removes the water that reaches it through the wells. So far as advantage has been taken of this water-absorbing capacity, no limit to it has yet been discovered. There is an average of a little more than one well to each of the 20 miles of the road. The water is lead to these wells in the ordinary way.

This method of disposing of surface water had been employed in southeastern Missouri at a number of points for a great many years and had been found to be the most satisfactory method of disposing of surface and drainage water. The highway wells have so far been entirely satisfactory and keep the surface of the ground practically clear of water, even when severe rains occur.

Build No Roads Less Than Eighteen Feet Wide

State Highway Commissioner H. E. Sisson, of New York State, advises the people of Pennsylvania against the construction of roads less than 18 feet in width.

"Some weeks ago," says the New York Highway Commissioner, "I came into Pennsylvania on a mission of discovery. I was agreeably surprised at the progress being made by this state. Shortly after I arrived home I received clippings from several newspapers in Pennsylvania showing that agitation had been started for the construction of narrow roads, on the presumption that they would be cheaper to construct, and, therefore, could be put down for a greater mileage. In other words, it was erroneously suggested that Pennsylvania could get twice as many miles of nine-foot roads as of 18-foot roads.

"New York state is not building nine-foot roads on new state highway construction. They are not sufficient to carry modern traffic. In some instances we have built a single strip of concrete eight or nine feet wide on one side of the road with the intention of building a strip of the same width on the opposite side the following season. But in this case the entire roadway must be graded, and culverts and the drainage system for a wide road installed. Therefore, the major portion of the cost of a wide road is expended at the time of the construction of a narrow road. The construction of half a road surface is an expensive proposition, as Pennsylvania would soon find out. The New York State Highway Department does not expect to design roads less than 16 feet in width in the future, except on thoroughfares of the least importance—and the trouble in this case is that heavy traffic follows improved highways, so that within a short time a minor hard-surfaced road becomes an important artery.

"I am proud of the Pennsylvania highway system as worked out by Commissioner Sadler. It is a marvel.

"Build your roads 18 feet wide and build the most important ones first. Counties in New York are building roads to connect with the main highways and they are doing a real job of it. The value of a small road is only in the value that it gets out of the main road."

Preventing Ice at Hydro-Electric Intakes

It is reported that the Ontario Hydro-Electric Commission is to carry out experiments in heating the waters of the St. Lawrence river at the entrance to the penstocks in order to avoid interference with the operation of the plant during the spring break-up of ice.

Recent Legal Decisions

PEDESTRIANS CROSSING EXCAVATED STREET MUST LOOK OUT FOR DANGERS CONNECTED WITH THE WORK

In an action against a paving company for injuries received while crossing a street excavated for paving, the Missouri Supreme Court holds, Waldmann v. Skrainka Const. Co., 233 S. W. 242, that where the plaintiff knew that the work was unfinished, and a red light warned her to look out for dangers, she was put on notice and bound to look out for dangers connected with the work, including stumbling or tripping on the exposed edge of the sidewalk, which she knew she would have to encounter and step over in crossing the excavation. Her testimony was held to show that she was guilty of such contributory negligence as prevented her having any case for the jury.

WAIVER OF NOTICE TO BEGIN IMPROVEMENT WORK —TAX BILL VOID BY DELAY IN COMPLETION

The Missouri Supreme Court holds, City of Brunswick v. Benecke, 233 S. W. 169, that the giving of notice to begin work on a street improvement provided for by an ordinance may be waived by the contractor. His intention to waive notice need not be proved by express declarations, but may be shown by the acts and conduct of the parties from which an intention to waive may be reasonably inferred.

It is also held that where an ordinance under the Missouri statute, authorizing improvement of streets in cities, Rev. St. 1909, par. 9411, provided that the work should be completed within 60 days, and it was not completed within 135 days, there being nothing to show that it was not needlessly delayed, a tax bill issued for the work was void, although the ordinance contained a penalty proviso.

COMBINATION AMONG BIDDERS RENDERS MUNICIPAL CONTRACTS VOID

The Texas Court of Civil Appeals holds, City Nat. Bank v. City of Corpus Christi, 233 S. W. 375, that the council of the city of Corpus Christi acted within the bounds of a sound discretion in rejecting bids made by two banks seeking the position of city treasurer, where the evidence showed that there was a tacit agreement between the parties to obtain the use of the public funds for a less sum than would have been bid if such agreement had not been made. The court said: "It is the settled rule of the law that arrangements and combinations among prospective bidders for municipal contracts to prevent competition among themselves, and to bring about an award at a figure which is not the result of an honest competition, are contrary to public policy and void. Such contracts being illegal and void, no inquiry is necessary as to the particular effect of the contract. Dillon, Mun. Corp., p. 1165, par. 781; People v. Stephens, 71 N. Y. 527; McMullen v. Hoffman, 174 U. S. 639, 19 Sup. Ct. 839, 43 L. Ed. 1117; James v. Fulerod, 5 Tex. 512."

CITY'S POWERS AS TO LICENSING AND REGULATION OF AUTOMOBILES FOR HIRE

The Florida Supreme Court holds, State v. Dillon, 89 So. 558, that the city of Miami has the right, under the provision of its charter, to require the drivers of all automobiles for hire using the public streets of the city, to obtain a license from the city, and, in the interest of public safety to inquire into and decide upon the qualifications and fitness of persons to operate cars. It may fix the rates to be charged for the transportation of persons or property, may require the drivers or owners of cars operating for hire within the city limits to give a bond to guarantee the payment of valid claims for injuries to persons or property, may prescribe the number of persons that may be permitted to ride at one time in any such automobile, and make reasonable rules and regulations governing the operation of automobiles for hire in the interest of public safety. The right to require a bond does not, however, authorize the requirement of a bond to an amount far in excess of what common experience teaches is likely to be necessary, nor to impose unreasonable conditions in the bond, or conditions that make it impossible for compliance with this provision of the ordinance. An ordinance providing for a $5,000 bond, with a continuing liability thereunder of not less than the full amount, notwithstanding any recovery thereon, was held unreasonable, and not authorized by the city charter.

MUNICIPALITY NOT PREPARED TO EXTEND WATER MAINS TO CONSUMER CANNOT PREVENT CONTRACTS WITH ANOTHER

Where it appeared that the water-distributing system of a town was at its nearest point at least 4½ miles from the plants of two corporations located within its limits, and it had taken no steps to extend its existing water mains so as to supply water to the corporations, the New Jersey Court of Errors and Appeals holds, Town of Kearny v. Mayor and Council of City of Bayonne, 114 Atl. 550, that the town could not restrain the execution of contracts between the corporations and another municipality for the furnishing of water, since the performance of these contracts could not work any present injury to the town, even if it had the exclusive right, under statute, to furnish water to the corporations; since a preliminary injunction will not be ordered unless from the pressure of a present urgent necessity, and the damage threatened to be done, and which it is legitimate to prevent during the pendency of the suit, must be, in an equitable point of view, of an irreparable character.

NEWS OF THE SOCIETIES

Dec. 5-8—AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS. Omaha, Neb. Secretary, J. H. Mullen, St. Paul, Minn.

Dec. 5-9—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual convention. New York City.

Dec. 6-9—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 14th annual meeting. Baltimore, Md.

Dec. 13—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary, N. L. Nussbaumer 80 W. Genesee Street, Buffalo.

Dec. 13-14 — EASTERN PAVING BRICK MANUFACTURERS ASSOCIATION. Annual meeting. Pennyslvania Hotel, New York City.

Dec. 14 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' building, New York City.

Dec. 15—ENGINEERS' CLUB OF CINCINNATI. Cincinnati.

Dec. 15 — BRIDGEPORT BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Hotel Stratford. Secretary Arthur R. Parker, Watrous Engineering Co., Bridgeport.

Dec. 15 — MERIDEN BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Home Club. Sec. E. W. Carruth, Aeolian Co., Meriden.

Dec. 15—TOLEDO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Loring Freed, Atlas Chemical Co.

Dec. 16—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, G. I. Rhodes, 115 Broadway, N. Y. C.

Dec. 20—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce. Secretary, Prof. W. H. Kavanaugh Un. of Penn.

Dec. 22-23—KANSAS ENGINEERING SOCIETY. Annual meeting. Hutchinson, Kan. Secretary, J. M. Averill, Topeka.

Dec. 22-23—KANSAS ENGINEERING SOCIETY. Hutchinson Kan.

Dec. 27-30—AMERICAN ECONOMIC ASSOCIATION. Pittsburgh, Pa.

Dec., 27-31 — AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SMITHSONIAN INSTITUTE, Washington, D. C. Toronto, Canada.

Jan. 4-14 — CLEVELAND, OHIO, BUILDING EXPOSITION. Municipal auditorium, Cleveland, Ohio.

Jan. 5-6 — AMERICAN ENGINEERING COUNCIL, FEDERATED AMERICAN ENGINEERING SOCIETIES. Annual meeting, Washington, D. C.

Jan. 17-19 — IOWA ENGINEERING SOCIETY. 31th annual meeting. Sioux City. Secretary—Lloyd A. Canfield, Des Moines, Ia.

Jan. 17-19—ASSOCIATED GENERAL CONTRACTORS. 3rd annual meeting. Hotel Winton, Cleveland Ohio.

Jan. 17-20—ASSOCIATION OF CANADIAN BUILDING AND CONSTRUCTION INDUSTRIES. 4th annual conference. Royal Connaught Hotel, Hamilton.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Jan. 18-19—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. New York City.

Jan. 27 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Bldg., New York City. Secretary—G. I. Rhodes, 115 Broadway, New York City.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING. 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' building, New York City.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention Curtis Hotel, Minneapolis.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

PROVIDENCE ENGINEERING SOCIETY

The Providence, R. I., Engineering Society at its meeting on November 15th was addressed by Alfred D. Flinn, secretary United Engineering Society, on "The Engineer's Road to Peace: Co-operation, Past, Present and Future."

NEW YORK ASSEMBLY, A. A. E.

At its meeting on November 12th in Albany the New York Assembly, A. A. E., elected the following officers: president, Germain P. Graham; vice-president, G. P. Hevenor; second vice-president, W. L. Everett; secretary-treasurer, J. G. Brennan.

IOWA SECTION, AMERICAN WATER WORKS ASSOCIATION

At its annual meeting on November 1, 2 and 3 in Omaha, the Iowa section, A. W. W. A., elected the following officers: chairman, J. Chris Jensen; vice-chairman, Peter Kern; directors, Harvey P. Letton and C. L. Ehrhart; and secretary-treasurer, Jack J. Hinman, Jr.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The Bridgeport branch of the A. S. M. E. will hold a meeting on December 15th, which will be addressed by Dr. Magnus W. Alexander, Chairman of the National Industrial Board on "World Wide Industrial Conditions."

The Meriden branch will also meet on this date at the Home Club. The subject of this meeting is "The Transportation and Storage of Coal." Harry R. Westcott, of Westcott & Mapes, New Haven, will address the meeting on "The Development of the Grand Avenue Station of the United Illuminating Company of New Haven."

Also on this same date is scheduled the meeting of the Toledo section. Features of this meeting will be an illustrated address on "Gas Manufacture, Distribution, etc." by A. Johnson, of the Atlas Chemical Co., Toledo, an address on "Industrial Fuel, by Henry O. Loebell, Henry L. Doherty Co., N. Y. C., and the showing of a motion picture film loaned by the American Gas Association.

The Metropolitan section will hold a meeting on December 16th, the subject of which is "Pulverized Fuel." In the afternoon the members will inspect the Babcock & Wilcox Boiler Co., Bayonne, N. J., followed by supper and a meeting in the evening. Speeches will be delivered on "Pulverized Fuel from the Operating Standpoint," by James A. Kinney, Bethlehem Steel Co., William J. Fantneyer, Puget Sound Power & Light Co., W. H. Maddocks, H. L. Kohlberg, H. R. Barnhurst, Fuller Engineering Co., Allentown, Pa., and H. D. Savage, Combustion Engineering Co., New York City.

On December 20th the Philadelphia section will hold a meeting in the form of a symposium on "Material Handling." This will be a joint meeting of A. S. M. E., Professional Division on Materials Handling, Philadelphia section of A. S. M. E., Engineers' Club of Philadelphia, Chamber of Commerce, A. I. E. E. and the Association of Iron & Steel Electrical Engineers.

PERSONALS

Barker, L. E., formerly engineer for the Pima County, Ariz., Highway Commission, has been appointed engineer with the Yavapai County Highway Commission.

McClelland, George A., has been appointed engineer of Harrison County, Texas.

Surman, H. E., formerly district engineer with the highway division of the Illinois Dept. of Public Works and Bldgs., at Dixon, has been appointed engineer in charge of design with the department, to succeed Frank T. Sheets.

Bowen, Carl T., has been appointed engineer and superintendent of roads in Ottawa County, Mich.

Elliott, John L., now senior assistant city civil engineer of Indianapolis, Ind., has been appointed city civil engineer by Lew Shank, newly elected mayor.

French, John V., has been elected mayor of Port Huron, Mich.

Whitford, Paul M., has been appointed superintendent of the Watchung, N. J., Water Co., to succeed Harry R. Cox, resigned.

Baker, George F., heretofore city engineer of Dayton, Ohio, has been appointed service director of that city. The position of city engineer is to be filled by Ivan E. Houck.

DeSavigny, H. J., has been transferred by the Saskatchewan department of highways from Weyburn to Swift Current.

Struthers, D. L., has been appointed highway engineer for Gaston county, with headquarters at Gastonia, N. C.

Dalton, E. L., of Dallas, Tex., has been appointed supervising engineer for water works improvements at Ferris, Tex., and for street improvements at Mexia, Tex.

Coe, Col. C. S., has been appointed city manager of Miami, Fla.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

FORDSON ROAD GRADERS AND TRACTORS

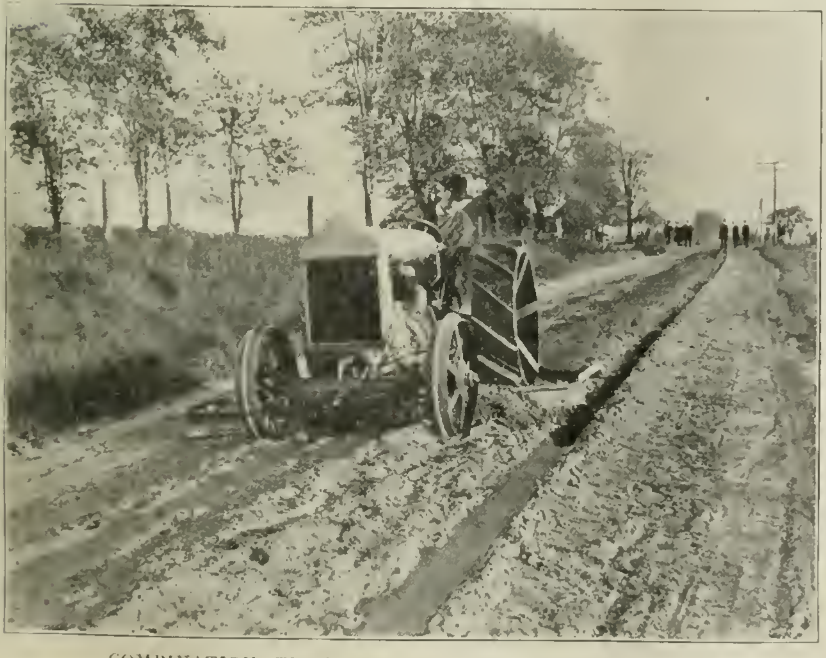
The road graders manufactured by the Wehr Company for operation by the Fordson Tractors are a combination grader and cleaner, designed to take the place of heavy, costly road equipment and can be operated under the most severe conditions, taking the place of the pony grader and enabling the road patrol to cover 20 miles per day instead of 8 miles per day.

The arrangement by which the operator is able to use the whole weight of the tractor provides a downthrust that is much more efficient than any scraper or road drag which merely rests on the surface of the road.

The cutting edge is below the power unit and ahead of the drive wheel. The distributing bar delivers the excess dirt and a 4-inch shoe allows the grade blade to deposit cuttings in low places. The 3-point toggle suspension gives absolutely independent movement for short turns, and backing is easy. The oscillating bar overcomes any unevenness, and the 5-inch road clearance permits for passing over railroad tracks. The grader is quickly attached and detached to the tractor by a simple connection having only three bolts.

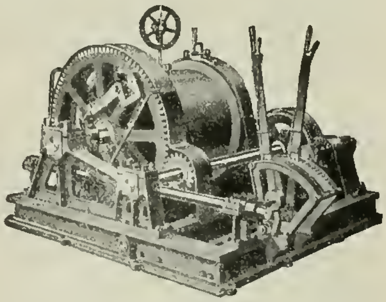
The manufacturers have just completed tests on a 2-ton trailer that carries one-third of the load on the rear of the tractor wheels and greatly aids the tractor and improves the traction. With this trailer the Fordson tractor will handle 2 tons under practically any condition and on 20 percent grades will pull the loads at second speed.

TWO TON TRAILER



COMBINATION TRACTOR, GRADER AND CLEANER, WITH THREE POINT TOGGLE SUSPENSION

FLORY BAND FRICTION HOISTS



FLORY BAND FRICTION HOIST

The Improved Type Band Friction made by the S. Flory Manufacturing Company, has been developed after many years experience with frictions and hoisting difficulties and transmits its power directly from the rim of the gear to the flanges on the drum, eliminating all torsional stress on the drum shaft. It remains locked when friction is in or out of contact, thus causing no end thrust in bearings or operating mechanism.

It consists of a simple system of levers actuating the rocker shaft to which the bands are fastened. The fulcrum of the bell crank rocker arm is placed on the spoke below the rim of the wheel to shorten the travel of the sleeve of the drum shaft. This construction reduces the distance between the gear and bearing to a minimum. The band is made in two pieces, each supported at one end by heavy pins, and the other ends are fastened to the rocker shaft. In case of accident to either half band the hoist can be operated with half the load at normal speed.

The operation consists in moving the sleeve along the drum shaft by either hand or mechanical power. To this sleeve is attached a connecting toggle link which actuates the rocker arm shaft, thereby tightening the bands. If hand operation is desired a lever is provided in the battery; if mechanically operated, air or steam cylinder is furnished and a valve controlling this is located at the battery of levers.

The single friction drum electric hoist, suitable for incline plane work, is equipped with the improved type band friction and one differential band brake with non-burnable lining. All gears have machine cut teeth. The drum is cast iron and bronze bushed where it runs loose on the shaft. The drum barrel is accurately balanced.

The housings are low and provided with long bearings lined with a high grade babbit and making a rigid construction. Operating levers are equipped with brass thumb latches working in notched quadrants and mounted in a battery. The chain driven dial indicator is furnished only on request.

This hoist has the wide range of from 2,500 pounds to 18,000 pounds rope pull at a speed varying from 100 feet to 800 feet per minute.

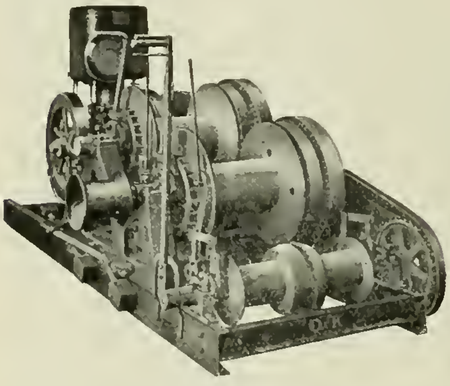
ECONOMICAL MUCKING

The thirteen Meyers Whaley Shoveling Machines now installed on the main tunnel of the Hetch Hetchy Aqueduct for the San Francisco water supply are credited in the report of city engineer M. M. Shaughnessy, with unquestionably accounting for "the maximum progress with minimum cost for the work; the average cost of 2,915 feet of rock tunneling, exclusive of overhead and plant charge being $27.46 per lineal foot, for labor and material."

This tunnel, 11½ feet in diameter and 19 miles long, is blasted in sections 9 to 13 feet long, for which the drilling and shooting is done in 14 to 16 hours, simultaneously with the mucking. When executed by hand the mucking costs $109.50 and takes 19 to 21 hours; by machine it costs $33.00 and takes 3 to 5 hours, making a net saving per shoot of $76.50 and 16 hours time.

O. K. HOISTING MACHINERY

Catalog 19 of the O. K. Clutch & Machinery Co., illustrates light and heavy duty single and double drum, light and heavy duty, geared hoists equipped with vertical gasoline engines or with horizontal kerosene engines, made in sizes of 3, 4½, 6, 8, 10 and 15 h.p., also reversible hoists with belt or engine drive and single or double drum hoists with electric motors.



DOUBLE DRUM HOIST WITH BOOM SWINGER AND VERTICAL ENGINES

It is claimed that the O. K. Hoists are built for constant duty, regardless of weather conditions and are self-contained, sturdy, simple, positive and reliable. They can be stopped or started quickly and easily and have cone asbestos lined friction drums requiring no adjustment, self oiling, phosphor bronze bushings and quick acting spring release, asbestos lined foot brakes.

All the hoists are equipped with end thrust ball bearings which reduce to a minimum, both friction and the power required for hoisting; something which it is claimed is not accomplished in any other type of hoists and which gives excellent results.

The gasoline engines are hopper cooled frost proof with enclosed crank case, the lower portion of which serves as a gasoline reservoir supplying the carburetor and containing enough fuel for 10 hours' operation.

The heavy duty double drum geared hoists with vertical gasoline engine and equipped with double drum boom swinger used for derrick service, are made reversible or non-reversible and will lift from 1,500 to 2,800 pounds on a single line at a speed of 150 feet per minute.

ST. MARYS OIL ENGINES

Super-Diesel 4-cycle oil engines, manufactured by the St. Marys Oil Engine Co., are operated on heavy oil, which gives an important economy over the fuel cost required for the same service for gasoline engines, and a still greater saving over steam engines. The engines are made in several types of 20 to 60 h. p., weighing from 8,800 to 22,370 pounds and occupying floor spaces of from about 9 x 14 to 10 x 11 feet. Small engines of 4½ to 9 h. p. are also built of this type for field power pumping units when combined with a water plunger. An engine of the 4½ h. p. size, when operated on crude oil at five cents per gallon is said to make an annual saving of $512 over the cost of the same size gasoline engine operated on gasoline at twenty-five cents per gallon.

The large engines are made with one-piece cast bed of the deep box center crank type with large foundation areas and main bearings cast integral at an angle of 45 degrees, thus relieving caps and studs of all strain. All parts of the horizontal engine are accessible from the engine room floor, very much promoting the ease of inspection and adjustment. The standard equipment furnished includes air compressor, air receiver, water circulating pump, mechanical grease cups, fuel tanks and other items.

This engine is radical in its simplicity. It uses neither an ignition system, carburetor, fuel pump or torch. Magneto, batteries, coils, spark plugs, wire, the dangerous blow torch for heating hot bulbs, plates and tubes are all done away with. Through the absence of these devices ninety-nine per cent of all engine trouble is claimed to be eliminated. No accessory equipment whatever is required, simply turn on the oil, turn the engine over, and it starts at once, regardless of weather conditions. The St. Marys "Super-Diesel" oil engine is primarily designed to operate on kerosene, solar oil, fuel oil or any cheap distillate liquid enough to flow freely through the fuel pipes. The intake exhaust, and fuel admission valves are operated mechanically.

This engine runs practically at constant speed. It operates just as well under variable or steady loads. Speed control is maintained under varying loads by means of a throttling governor. The governor is connected with the fuel admission valve and automatically varies the amount of fuel in accordance with the load, thus maintaining a constant engine speed.

The first stroke is called the intake stroke. Fuel admission valve opens and oil under gravity, together with a slight amount of air, is admitted during this stroke into the fuel cup. This cup is a compartment on the inner end of the fuel valve assemblage and projects into the combustion chamber.

The next stroke is the compression stroke. When the compression becomes sufficient, ignition takes place in the fuel cup. The fuel cup is in direct communication with the combustion chamber proper. Air in the cylinder is forced into the fuel cup. The oil is changed to gas. A great amount of heat is generated. The air and oil gas expand and force the piston back.

Next in order is the power or expansion stroke. Power is transmitted from the piston through the connecting rod to the flywheels.

Finally there is the exhaust stroke. At the start of the exhaust stroke the exhaust valve opens and the burned gases are forced out.

INDUSTRIAL NOTES

The H. W. Clark Company announces an increase in its capital stock from $75,000.00 to $200,000.00 ($150,000 common and $50,00 seven percent preferred cumulative).

A one hundred per cent stock dividend was declared out of the earnings of the Company, and some of it's common stock as well as some of the seven per cent cumulative stock is offered for sale.

EFFICIENCY OF DEMOUNTABLE TRUCK BODIES

E. C. Jarden, president of the Jarden Brick Co., Philadelphia, writes:

"We have been using the Fontaine Demountable Truck Bodies mounted on Packard Chassis for a period of about seven months. We have found them economical in the delivery of face and common building bricks for close local business in various ways.

The old method of handling face brick was for the truck to stand while being loaded, which required from 30 to 40 minutes and then to stand at the operation the same length of time while unloading, while with the demountable truck the body is loaded while the truck is on the street so that the chauffeur backs up and picks up the load requiring about 3 to 5 minutes and is on his way. On arriving at the job it requires about the same length of time to deposit the load piled up in an orderly manner without handling or breaking a brick.

The saving to us is accomplished in keeping the truck continually on the street and hauling twice as many face brick as the ordinary truck of same capacity the same distance. In addition the loaders are working constantly and not standing around between loads waiting for trucks to come in as heretofore.

In handling common brick or material that can be dumped, the saving in time is not as great although two or three additional loads can be hauled by saving in time of loading only. In addition there is no breakage and a saving in space where room is an object.* * *

Our bodies are made to hold 1,500 brick which is the most practical load for the equipment—and we find an advantage on short hauls as we effect a greater saving on them. The average saving over monthly periods is from 50c. to 75c. per m. brick.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 51 DECEMBER 10, 1921 No. 24

Constructing the Duncannon Highway

Eight miles of Pennsylvania State Route No. 195, built in 1920-21 on old location, including widened rock cut in hillside. Excavation with blasting, steam shovel and machine graders. Pneumatic drills sometimes operated from tall ladders. Valley side of road extended by fill hauled in trucks from steam shovel in borrow pit. Imported aggregate unloaded from railroad cars to storage piles over loading tunnel beyond end of route and delivered by relay trains on 8-mile industrial track.

Section 1, of Route 195, of the Pennsylvania State Highway system, is a portion of the Duncannon Highway, 7.93 miles long, from Clarks' Ferry bridge on the Susquehanna river 18 miles northwest of Harrisburg, in Perry county, to Girtys Notch. It is located part of the way on a narrow shelf, excavated on the side of Blue mountain, close to the bank of an old and now disused feeder canal. It passes through a picturesquue and sparsely settled country where there is little local traffic at present, but where there will be a large amount of automobile traffic and trucking over the trunk line of which this route forms a portion.

The road is being built under a $480,000 contract awarded in 1920 by the State Highway Department, Lewis S. Sadler, commissioner, to McArthur Bros., of New York. Thomas Dixon is superintendent for the contractor and George P. Searight is district engineer for the state.

The alignment is nearly all an old location modified by widening the roadbed and improving grades and curves. On this is laid a new reinforced concrete pavement 18 feet wide, 6 inches thick at the edges and 8 inches thick in the center. The 1:2:3 concrete is made with stone 5/8 inch to 2¾ inches in diameter, reinforced with a single thickness of galvanized steel mesh weighing 25 pounds per 100 square feet. The maximum grades are 5 per cent and the sharpest curves have a radius of 360 feet and are built without banking except two curves which have a radius of 140 feet and which are widened and banked.

There are nine concrete bridges with spans of 4 to 12 feet, including one 4-foot and one 6-foot arch, the others being flat slab or girder construction. The numerous culverts are of hub and spigot reinforced concrete pipe from 12 to 30 inches in diameter, which are cast at the manufacturer's yard, delivered by rail and set in concrete walls at both ends. The principal quantities include 19,000 yards of unclassified excavation, 24,000 yards of fill and embankment, and 84,000 square yards of concrete pavement, besides the bridges, culverts and rails and other items. The unit price for the pavement was $4.00 per square yard and the total amount of the contract computed on the estimated unit quantities is $481,784.55.

EXCAVATION AND GRADING

During construction all traffic was detoured and all operations were carried on progressively from the south to the north end of the route and were served by a 24-inch Koppel industrial track about 8 miles long laid from the storage yards on the opposite side of the Juniata river to Clarks Ferry bridge as fast as subgrade was advanced.

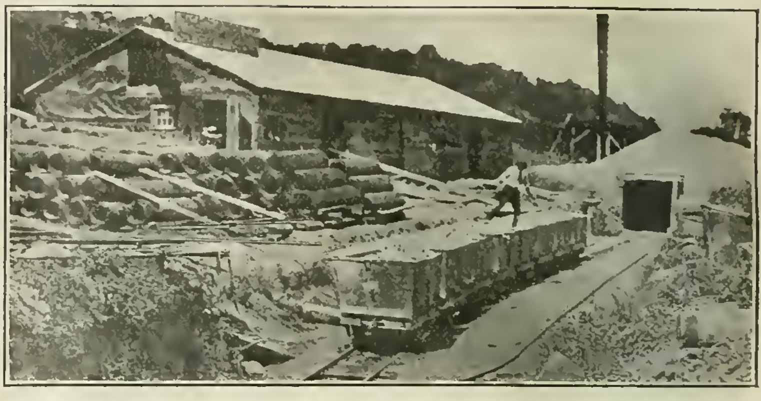
For about 2½ miles the road is located on a terrace in the steep, rocky banks of the Blue mountain along the side of the narrow wooded valley and close to a narrow canal with water level from 10 to 30 feet below the road level.

The industrial track was laid on the 5-foot shoulder of the up-hill side of the roadway, and the downhill side of the roadway was widened in places by rock fills, provided by adjacent cuttings and in other places by earth fills, excavated by an Osgood steam shovel with a ⅝-yard bucket delivering directly to motor trucks.

The rock formation was chiefly shale and limestone in very irregular stratifications and the face of the cut varied from nearly vertical to a slope of 1 on 10. Most of these excavations consisted of trimming the steep slope to an average depth of about 2 feet to remove all projecting and loose or decayed rock and give abundant clearance for the shoulder and for the industrial trains operated there. The height of the cut varied up to 30 feet. The rock was shattered by blasting with 60 percent dynamite cartridges, exploded by electric batteries in holes from 2 to 5 feet deep, drilled with jackhammers often operated by men equipped with safety lines or working from the tops of ladders. The light charges only loosened the rock or tumbled it down to the bottom of the slope, where it was often wheeled across the road and dumped on the downhill face of the embankment to widen the roadway, or was loaded into horsedrawn carts and hauled a short distance to spoil banks or fills.

In two places the rock cut was eliminated by an offset of the alignment introduced to preserve the existing contours of the mountain side, which bore fancied resemblances to the profiles of the former German Kaiser Wilhelm and of the earlier local marauder Girty, from which the two localities were named respectively Dutchman's Face and Girty's Notch, and had become historical landmarks that were preserved by carrying the road out around them at the expense of an encoachment of about 3 feet into the canal.

The maximum fill of 6 feet was made with spoil excavated in the borrow pit. Most of the grading was accomplished with a Western grader, having a 6-foot blade. The light excavation was done by hand, and by scrapers with a gang of 9 men besides the operator of two Buffalo-Pitt steam rollers and a Western Grader Company's scarifier, that broke up the old road surface. The bridge and culvert gangs followed the excavating and grading gangs and were equipped with a 1-bag portable Rex paving machine for mixing the small quantities of concrete required for the culvert end walls. The concrete for the bridges was mixed in a 2-bag Koppel machine.



AGGREGATE, CEMENT, AND REINFORCEMENT STORAGE IN CONTRACTOR'S YARD

UNLOADING AND STORING

The construction materials included about 32,000 barrels of cement from the Pennsylvania Portland Cement Co., in Nazareth; 20,000 tons of stone from J. E. Baker, New Holland, Pa.; 9,700 yards of sand from the Defrain Sand Co., Philadelphia, and the steel reinforcement fabric, all delivered on the Pennsylvania Railroad to the contractor's siding about 500 feet long and 1,000 feet beyond the south end of the route.

The cars were unloaded by a clamshell bucket operated by a guy derrick that deposited the sand and stone in storage piles over an 8- x 8-foot timber tunnel 160 feet long, built with bents of 7- x 9-inch timber 4 feet apart on centers and having in the flat roof four horizontal sliding gates for delivering stone, and four for delivering sand to Koppel steel batch boxes on flat cars on the industrial track that passed through the tunnel, alongside a cement storage house that had a capacity of 15,000 bags (5 cars), crossed the Juniata river on a single-track bridge 750 feet long and thence continued along the shoulder of the highway to the farther end of the contract section.

BUILDING UP OUTER SLOPE WITH ROCK BLASTED FROM FACE OF SIDE HILL CUT

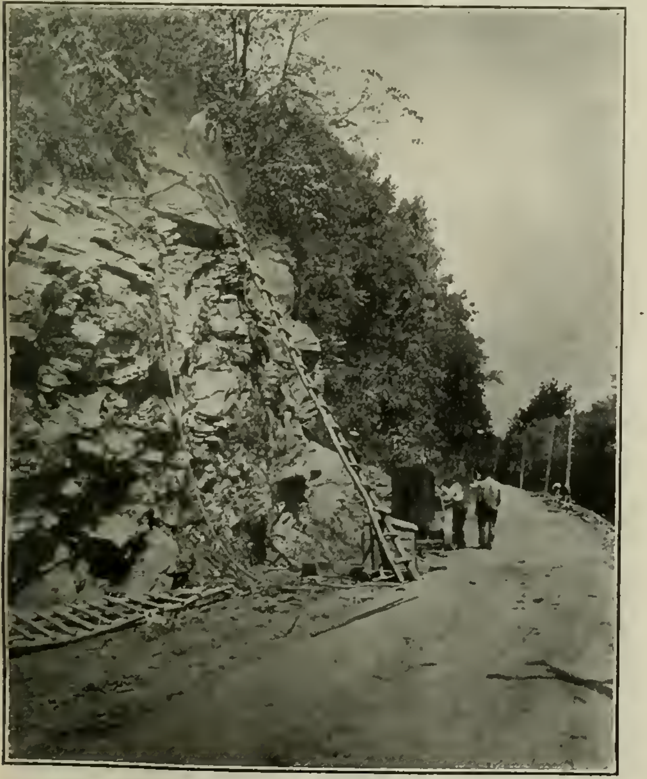
The rolls of reinforcement fabric were stored adjacent to the cement house and nearby were piled 10-foot sections of industrial track that were transported to the advancing end of the finished subgrade on the flat cars used for handling the batch boxes. The piles of track 10 feet high were secured to the cars by a vertical bolt at the center, making the topheavy mass so secure that it was transported safely by the small cars over the rough road bed. Ordinarily about three 30-ton cars of broken stone, two of sand and one of cement were delivered daily and the sand and stone discharged from bottom-dump cars to track pits from which the aggregate was transferred to the storage over the tunnel roof as before described by the clam shell and derrick system.

Ordinarily the bags of cement were unloaded directly from the car door to the batch boxes on the industrial cars alongside, any excess being placed in the store house for reserve. The capacity of the siding was six cars of aggregate and three cars of cement, but as a safety precaution, additional cars were generally held in the railroad company's storage yard, thus incurring some demurrage charges that would have been avoided if it had been practicable to establish a longer siding for the contractor. Generally about 1,000 tons of broken stone and 500 tons of sand were maintained in storage over the tunnel roof.

In the storage yard there were ordinarily employed three men unloading the railroad cars, one man loading cement, one loading sand and one loading stone into the batch boxes, one man directing cars in tunnel, two men carrying cement bags, one derrick man, one oiler, and one foreman. The cement bags were shaken and baled during intervals between material trains, which were run on a headway of about 25 minutes.

HAULING MATERIALS

Two batch boxes were loaded on each flat car and eight cars were run to a train. The trains were hauled by four Whitcomb and two Plymouth locomotives, all of them driven by gasoline. Two of the locomotives were usually held in reserve and four were in constant operation hauling trains that made the round trips in about 1½ hours. The haul was divided into four divisions of different lengths according to the grade, and it was found that better results were obtained by changing locomotives at each division. The first division, including the long bridge, had the steepest grade and it was the shortest because the locomotive could only haul four-car trains, and therefore were required to make twice as many trips as on the other divisions where the trains were made up of 8 cars for16 batches of aggregate. The running time of loaded train hauled over all four divisions was about 40 minutes, the return time was about the same, and a few additional minutes were required for loading and shifting in the storage yards.



TRIMMING FACE OF DEEP SIDE HILL CUT

The full cars were run opposite the mixer on the main line of the industrial track which extended several hundred feet beyond the mixer in the end of the subgrade. As fast as the cars were unloaded by the mixer derrick, the empties were pulled back a short distance toward the storage yard and switched to a siding, where they were made up into a train and returned to the storage yards as soon as a new train pulled in and occupied the space adjacent to the mixer.

(To be continued)

Minor Repairs to Sheet Asphalt

An appliance adapted especially to making minor repairs to sheet asphalt pavements in cities too small to support a permanent asphalt plant is something greatly to be desired, in the opinion of August E. Christhilf, highways engineer of Baltimore, expressed in a paper before the A.S.M.I. He thinks that the burners or heaters of the Luten type are not adaptable to this work, while the usual method of cutting out, concreting and hauling hot stuff for a number of miles, during which it cools in the wagon or truck, is not efficient. Cuts made in sheet asphalt are generally so small in area and so widely distributed as to make the cost high and the work unattractive to a contractor. Contractors will not generally start a plant in operation until enough yardage of patches has accumulated to make it worth while.

The author suggests as desirable a small outfit on wheels containing a burner to supply the necessary heat, with compartments to heat and keep warm the necessary paving mixtures. He did not think it practicable to actually perform the mixing on the street, but if mixed at a larger plant and delivered to the street outfit it could be kept hot until all of it had been used. Or a mixure could be made and stored in loose piles, and when needed the loose mixture could be heated in the outfit and used for emergency repairs. Such an outfit could contain compartments for hot asphalt cement, top mixture, heating irons, and a bin for portland cement.

He did not think it practicable to heat the several materials separately and mix them on the job, as the making of such a mixture is an exact operation and should be done by men trained in that particular work. If done on the street by repair men it is more than probable that the result would be unstable mixtures that would soon shove and leave the pavement in as bad condition as before the patch was made.

With a load of topping in such a heater, the patch gang could work full time, moving from cut to cut. There would be no necessity for using binder in these patches, as the pavements patched are usually worn so thin that, if binders were used, the wearing surface would be too thin; moreover it is much more difficult to get a good joint when using binder than with topping alone.

"Such an outfit would be particularly useful in small towns where they have an area of asphalt laid by contract and where there is not enough business to support an asphalt plant. I have seen many instances of this kind where the sheet asphalt pavements are going to pieces for want of attention and the towns are not able to get a contractor to bring in a plant for the small area involved. In such cases patches are usually made with stone and poured with bitumen, or are filled with cold patch mixture, both methods being inefficient and tending to ruin what might be a good pavement."

The author was in doubt whether this outfit should be self-propelling but inclined to the belief that it should be arranged to be attached behind a truck and hauled by it from one location to another or else by a team; the truck, if used, serving the heater with hot material. He suggested a capacity of not more than one ton of hot mixture. The chief object in view is to allow cuts to be closed up promptly and patches made as soon as needed, since the convenience of the public is of the first importance in the city work.

Highway Construction in the United States

The enormous importance of highway construction is forcibly illustrated by the statements recently made by the American Road Builders' Association concerning the number of contractors and others directly interested in such work, the present and future expenditures on new roads and the cost of material and equipment involved.

There are now identified with the road industry 80,000 public officials, 7,000 road contractors, 2,000 bridge contractors, 1,196 manufacturers and dealers in road building machinery and materials, 7,338 firms manufacturing highway transportation equipment, 25,000 civil, highway and chemical engineers and 842 national, state and local highway associations and engineers' and contractors' organizations.

There are 200 firms manufacturing Portland cement for road building, with an annual output of 125,000,000 barrels valued at $375,000,000; 127 firms manufacturing brick valued annually at $7,145,000; 46 wooden paving block manufacturers with output of 59,000,000 blocks valued at $4,000,800; 23 manufacturers of granite paving blocks with output of 26,000,000 blocks valued at $1,547,000; 380 dealers in crushed stone with an output of 9,700,000 tons for road purposes valued at $9,500,000; 42 asphalt manufacturers with production of 1,000,487 tons valued at $44,610,000, and 345 firms producing 23,000,000 tons of sand and gravel of a total value of $13,000,000. The combined capital investments of these 1,069 firms is $558,000,000.

In addition to these there are 7,338 firms manufacturing trucks, tractors, automobiles and other vehicles dependent upon good roads and having a total capital invested amounting to $6,000,000, an amount exceeding one-third the capital of the country's railroads.

In 1919 approximately $400,000,000 was spent on road construction in this country; in 1920 about $600,000,000, and it is estimated that for 1921 approximately $800,000,000 will have been spent. For next year nearly $1,500,000,000 are available for road construction and it is expected that actual cash expenditures will pass the billion dollar mark. More money is now being spent on road construction than on all other public works combined.

Rapid Highway Bridge Work

By H. D. WILLIAR, JR.*

Maryland has 1,700 miles of improved State highways on which there are a number of one way bridges. Most of them are Pony Truss, from 12 to 14 feet wide, with 25 to 125-foot spans. All of these bridges were constructed some years ago when traffic was light and slow-moving, and at that time were entirely adequate.

The State Roads Commission, since its inception in 1908, has replaced these bridges with modern two-way concrete structures as rapidly as circumstances demanded and as finances permitted, until at present there are but 48 narrow bridges on the State System.

Notwithstanding the fact that all of these danger points are posted "One Way Bridge," with large signs 250 feet away from each end of the bridge, they are frequently the scenes of accidents. Fast-moving traffic, willing to take a chance, often gets jammed on these bridges, resulting not only in serious injury to life and cars but in some cases completely wrecking the bridge. In instances where the bridge is damaged, immediate and quick action is necessary on the part of the State Roads Commission to make repairs with the least interruption or inconvenience to the travelling public. It may be that minor repairs are all that is necessary; in other cases, abutments have to be underpinned, or timber bents constructed at weakened panel points, while in one instance an entire new bridge had to be built. It was in building this bridge that Maryland set a record for rapid highway work.

On the Washington-Baltimore Boulevard, at Savage, Maryland, there was a pin connected steel bridge 101 feet long over the Little Patuxent River. This bridge had a height of 18 feet and a driveway of 13 feet and was posted on each side "One Way Bridge." Despite this fact, a 5-ton truck, loaded with asphalt,

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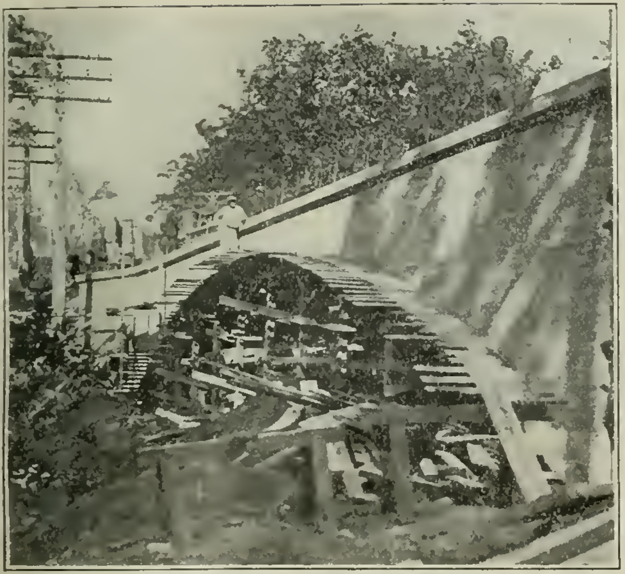
*Assistant Chief Engineer, Maryland State Roads Commission.

RUINS OF PIN-CONNECTED STEEL TRUSS SPAN



BRIDGE COMPLETED, WITH FALSEWORK AND CENTERING STILL IN POSITION

tried to pass a Dodge roadster on the bridge with the result that the two sideswiped and the truck was thrown through the side of the bridge, knocking out a number of vertical and diagonal members. Naturally, the bridge collapsed and settled down in the river. This was at 7.00 A.M.—September 21, 1921.

The State Roads Commission in session, authorized the Chief Engineer to enter into a contract for the immediate building of a new reinforced concrete arch at this point. This was on September 22nd.

Plans were prepared, three bids received, and the contract for the bridge to be completed within 30 working days was awarded to the Luten Bridge Company of York, Pennsylvania, at their bid of $19,000. This was on September 24th.

One crew of men with acetylene torches and one with block and tackle started to dismantel the old bridge on September 24th and had the site entirely cleared by September 25th.

The plans called for a 24-foot roadway reinforced concrete arch with a span of 97 feet and a rise of 18 feet. The contractor started work on September 26th.

NEW BRIDGE IN SERVICE WITH FALSEWORK STILL IN POSITION UNDER ARCH

While the excavating for the abutments was being done, another force of men was erecting the centers, so that on October 6th the two abutments were poured. The arch was poured in two rings and on October 10th the pouring of the up-stream ring started. On October 12th, both rings were completed The first spandrel wall was completely concreted on October 15th, the second started on October 17th. Backfilling began on October 19th and traffic was turned over the bridge at noon on October 22nd.

Highway Construction in Wisconsin.

A. R. Hirst, Wisconsin State Highway Engineer, says that "this year there will have been expended in all types of road and bridge construction in Wisconsin approximately $24,000,000. In addition there will have been expended approximately $500,000 for machinery and for gravel pits and stone quarries, the cost of which is not included in the construction item.

"There will have been expended approximately $4.000,000 for the maintenance of state trunk highways, county trunk highways and state aid roads. In addition there will have been expended about $750,000 for state, county and federal supervision, not charged as a part of the cost of the above work.

"There have been built about 340 miles of concrete road, about 1,100 miles of gravel surufacing, about 100 miles of miscellaneous surfacing, and about 1,000 miles graded but not surfaced, making about 2,540 miles of all construction.

"There have been maintained 7,500 miles of state trunk highways, and the counties have maintained about 5,000 miles of county highways.

"Out of the maintenance funds there will have been surfaced with various materials, largely gravel, about 250 miles of road, and there will have been re-graded under gang maintenance methods (that is, heavy road machine work) about 50 miles, so that in addition to building to standards the 2,540 miles stated above, we have materially improved the condition of 1,200 miles with maintenance funds, making a total of 3,740 miles of road which has suffered some change for the better in its condition as a result of this year's work outside of the results gained from the maintenance."

Use for the Old Erie Canal.

In constructing the new Erie ship canal, the location of the old and smaller canal was followed where possible, but considerable stretches of it were abandoned for locations more favorable to the larger canal. Most of these stretches remain in the possession of the state, but are offered for purchase by cities or other political units in which they are situated. The city of Rochester is expecting to purchase eight miles of the canal that lie within its limits, title to pass on December 21st of this year. The use to be made of the canal has not, we believe, been officially settled upon, but the city contemplates building a subway from Oak street to South avenue and the construction of an electric railroad in the bed of the canal linking up the other roads and giving access to the center of the city for suburban cars. It will pay for the canal by means of a bond issue. It is hoped to begin work on the actual construction for utilizing the canal early next spring.

The Pittsburgh Test Highway

Some of the observations made and figures obtained in test of concrete road described in our issue of October 29th.

MEASURING FLEXURE BY MEANS OF EXTENSOMETER

Test operations were begun during November on the Pittsburg, California, test highway described in our issue of October 29. On November 9th forty motor trucks began an endurance run on the highway, but previous to this two trucks had been used in making various tests which could not well be made after the endurance run had started.

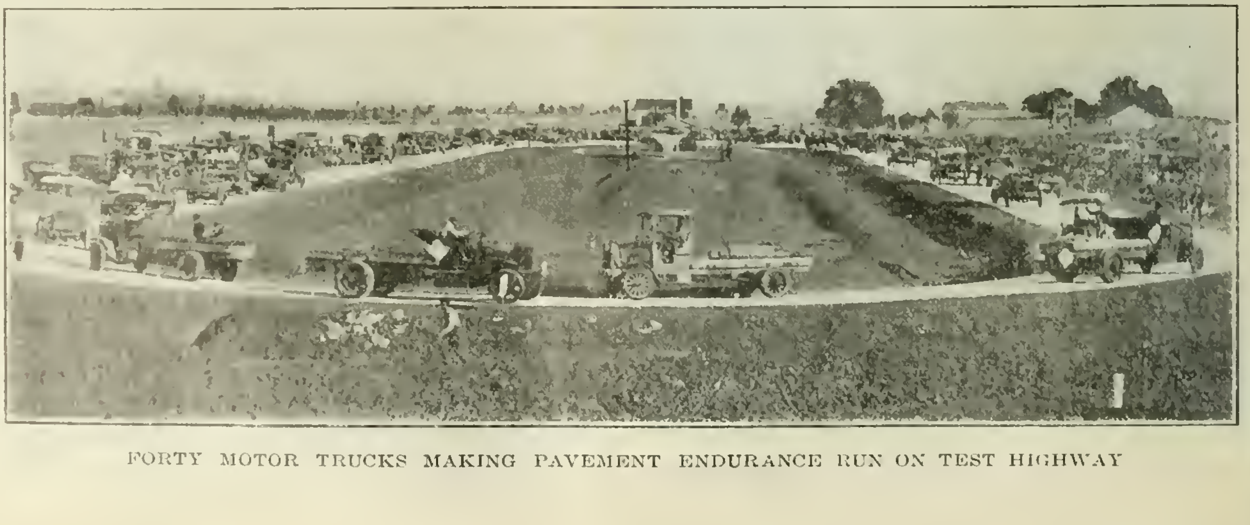
These preliminary tests includued a moving load test, a static load test and an impact load test. In making the impact test, planks of different thicknesses were placed across the track directly over the roof of the observation tunnel, and the motor truck was driven over these planks. Impact tests were made with ½-inch fall, 1-inch, 1½-inch and 2-inch fall. The truck was loaded with pig iron giving a total weight of 14,500 pounds. Nine steel rods extend from the concrete road slab into the observation tunnel, these rods being set in a line at intervals of 2 feet at right angles to the line of the road. The slab here is 6 inches thick and reinforced with 3/8-inch steel bars placed in the top and bottom of the slab diagonally 9 inches on centers. The lower end of each rod operates a recording pen which makes a permanent record of the slab deflection on a traveling record sheet. In addition to these pens, Ames dials were installed in the tunnel, one for each rod, which registered the slab deflection in thousandths of an inch. When the observations are being taken, one man is stationed at each dial to note the registration on his particular dial and these figures are later taken to the office and recorded.

When the truck passed over a plank giving a 2-inch fall, the truck wheels being 17 inches and 7 feet respectively from the edge of the road, the pavement under the outside truck wheels deflected .035 inch and the pavement under the inside truck wheels deflected .017 inch. At 2 feet inside the inside wheel the deflection was about .012, at 4 feet it was about .003, and about .001 at 6 feet from the inner wheel. When the fall was only half an inch, the deflection under the outer wheel was about .018, under the inner wheel it was about .007 and 4 feet from the inner wheel was about .001 The static deflection for the same truck was .008 under the outer wheel, .003 under the inner wheel and .001 four feet to the right of the inner wheel.

The curve of deflection under the static load was practically a straight line from the edge of the road to a point 4 feet inside the inner wheel. Under a moving load the deflections were a very small amount less than under a static load. But, under both moving load and impact loads the deflection was less between the two wheels than it was at the inner wheel and considerably less than at the outer wheel. This impact test was assumed to simulate the effect of a tire in bad condition, and a badly broken tire was run over the road and the records taken as above.

The moving load test was taken with a truck traveling at 12 miles an hour and indicated that at this rate the deflection and therefore the stress on the slab was less than with a truck standing still.

Under a moving load the rod on the outside of the pavement noted a deflection when the front wheel of the approaching truck was still about 6 feet from the line of the rods, and became .004 when the front wheel was directly over the rod. As the front wheel passed on, the rod rose slightly to de-



FORTY MOTOR TRUCKS MAKING PAVEMENT ENDURANCE RUN ON TEST HIGHWAY

MEASURING EXPANSION DUE TO OPENING OF CRACK

TAKING TEMPERATURE OF CONCRETE

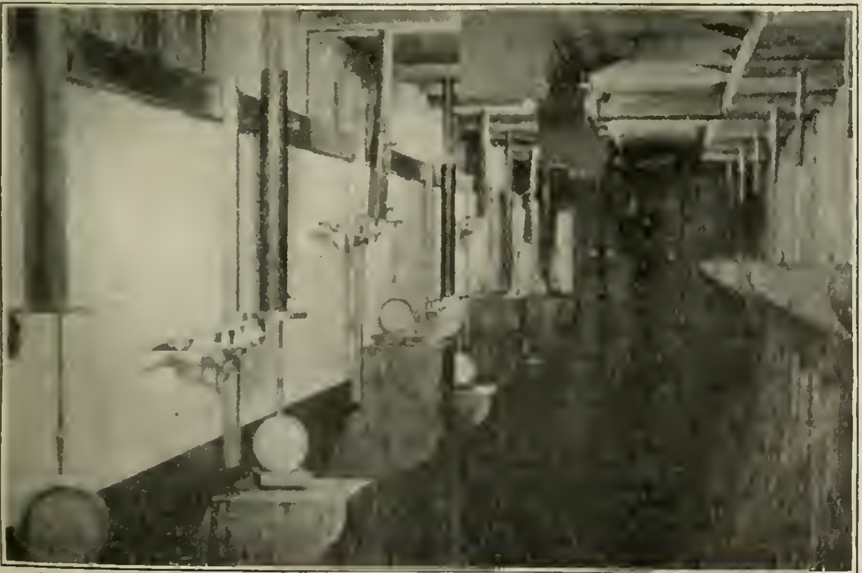
flection .002 and then fell rapidly to .008 as the rear wheel came over the line of rods. The same effect, but relatively less, was noted in all of the rods on the same side of the road as the truck, the one 2 feet inside of the inside wheel returning to approximately zero deflection after the front wheel had passed and before the rear wheel reached the line of rods.

In making the test for deflection under an approaching load, the pavement both sides of the observation tunnel was marked off into foot sections for 25 foot each way. The loaded motor truck was then run slowly toward the tunnel, stopping every two feet to permit the dials to be read for each position. The wheel base of the truck was 13 feet 4 inches. The rods did not return to zero deflection until the rear wheels of the truck had traveled to a point 40 feet beyond the tunnel, although they had not indicated any deflection until these wheels were within about 23 feet of the tunnel on approaching.

The various cracks in the pavement are charted as they develop, a separate chart being provided for each section of pavement. Each day the cracks that then appear in the pavement are entered on the proper chart. By this means the development of each crack is recorded. One interesting fact is that up to the present time no longitudinal cracks have appeared in any of the reinforced sections but they have appeared in sections that are not reinforced.

At one section 150 feet long deflections due to temperature are measured by Ames dials, these measurements being taken at 6 foot intervals on each side of the road, steel rods being driven deep into the earth at the points where the dials are to be used.

Temperature of the concrete in the road bed is taken by a method out of the ordinary. Holes have been bored in each of the 13 sections of pavement. At each point, one hole extends to near the bottom of the pavement, one to the mid-depth of the pavement and a third to a short distance below the surface. These holes were swabbed with a waterproof lining to make them waterproof and a quantity of mercury



INTERIOR OF AN OBSERVATION TUNNEL

Along the left wall is the traveling record sheet, on which the deflections of the pavement above, multiplied several times, are recorded by pens actuated by nine vertical rods embedded in the concrete. At the bottom of each rod is an Ames dial that register deflec-tions to thousandths of an inch.

TIRE USED IN MAKING IMPACT TEST

TAKING BORING SAMPLES OF SUBGRADE

placed in each hole, which was then plugged with a cork. In taking the temperature, the operator removes the cork and inserts a thermometer in the mercury at the bottom of the hole. The thermometer remains in the mercury for one minute, at the end of which time the temperature that it registers is recorded. Thus the temperature at the bottom, middle and top of the slab at this point are obtained. This system is considered to be much preferable to that of burying thermometers in the concrete. The mercury in the holes acquires the same temperature as the concrete surrounding it and imparts this to the bulb of the thermometer.

Borings are taken from the subgrade at intervals to determine the condition of the soil as to water content, etc. Holes were provided in the concrete for making these borings, which are kept plugged with wooden plugs except when borings are being made.

Road Work by Reformatory Inmates

In the spring of this year the state highway commission of New Jersey entered into an agreement with the board of managers and the superintendent of the New Jersey reformatory at Rahway to use some of the young men from the reformatory for road work in Morris county. Work was begun in April with a gang of 50, which had increased to 98 by May 3rd, but at no time after that exceeded 94. The young men worked on all sections of the road, many times miles away from the officers and alone. There were no complaints from the residents of the section in which they were working as to their conduct and in fact their deportment was commented upon favorably. Only six of the entire number attempted to escape and four of these were later returned. The road built by them is of concrete approximately four miles long and 20 feet wide, with graded shoulders. The concrete is reinforced, 8 inches thick in the center and 6 inches on the side. The men also did considerable guard rail work.

Human Factors in Operating Sewage Treatment Plants*

By JOHN H. DUNLAP†

Most failures of plants are due to operation, and very few plants are operated by competent men. The author suggests that state health boards require weekly reports by operators and expert supervision.

With proper design and construction of sewage treatment plants assumed, their operation resolves itself into two problems, first, the problem of the control of the biological factors involved; and second, the control of the human factors involved. As here used, the phrase "biological factors" is intended to include the activities both of vegetable and of animal organisms.

The general relation between bacteria and organic decomposition is one of the most important in the marvelous workshop of nature. Were it not for the steady fidelity of bacteria to nature's laws, this world would in a short time become uninhabitable for human beings. Organic matter would become piled mountain high, all those processes would cease by which organic matter is returned to mother earth to begin again the never-ending cycle of transformation, and life as we know it would perish.

Whenever the biological laws of nature, providing for the transformation of organic matter into harmless mineral compounds, are interfered with by man, disaster results. Usually this is the fundamental reason why our sewage treatment plants are doing unsatisfactory work. Bacteria can always be relied upon to conform to law, and to do their work with unceasing fidelity. Mankind alone, of all living beings on the earth, cannot be relied upon to perform his part in the world of nature. Mankind alone, through the exercise of his power of choice, may or may not react to the needs of the hour in a logical manner.

This human phenomenon is so marked that it has led Harrington Emerson, the noted efficiency expert, to remark: 'You can trust a dog, a horse and animals, but when it comes to the human being you must count on his doing the wrong thing."‡

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*Slightly condensed from a paper at the Third Conference on the Operation of Sewage Treatment Plants, held at Iowa State College, Ames, Iowa, October 26-28.

†Professor of Hydraulics and Sanitary Engineering, University of Iowa, Iowa City, Iowa.

In contrast with this, we have to confess that bacteria may be relied upon to do the right thing. This same fact is well expressed by the motto which Edison is said to keep on his desk: "There is no expedient that men will not adopt to avoid thinking."

Bacteria, on the other hand, adopt no expedients in order to avoid duty. They react to environment in complete harmony with the laws of nature.

THE HUMAN FACTORS

The tendency of mankind to do the wrong thing, and to avoid thinking, is demonstrated forcibly in the operation of sewage treatment plants. In fact, the chief failures in operation are usually human failures. Doctor Thresh, Medical Officer of Health for the County of Essex, England, in an address before the Association of Managers of Sewage Disposal Works, once made a statement somewhat as follows:

> "I have so repeatedly seen excellent works give bad results on account of inefficient management, and very defective works give fair results on account of the efficiency of the manager, that I have come to regard the manager as being even more important than the works."†

In this connection the writer must confess that he has visited scores of sewage treatment plants, at one time or another, and has yet to find a plant which was not laboring under difficulties, usually of inefficient management. In making this statement, it would not be fair to place all the blame upon the men who are theoretically in direct charge of operation of these plants. Usually the cause is farther back and may be located only by an anlysis of our inefficient American plan of city and town government. The conduct of the business of our cities and towns is, by our American system, placed each biennium, for the most part, in the hands of new and untried men, quite unacquainted with the city's business as a whole, and perhaps, failing to understand most disastrously of all, such a complicated machine as a sewage treatment plant. The common mistake made is to conclude that the sewage treatment plant is automatic, and therefore needs little or no attention. Accordingly some individual like the water works superintendent, or the chief of police, or the city clerk, or some one who already has more to do than he can do, is assigned the task of operating the sewage treatment plant. Naturally, under these conditions the plant is neglected.

THE SITUATION THROUGHOUT THE UNITED STATES

In order to ascertain how far the human factor involved in the operation of sewage treatment plants was performing its share of the work, a letter was sent to the sanitary engineers of the State Board of Health of each of our forty-eight states. The letter requested an outline of the law, or of the rules, followed in the control of the operation of sewage treatment plants.

Forty-one replies to the forty-eight letters were received. Judging from these forty-one replies, apparently only eighteen states are now requiring the submission and approval of plans for sewage treatment plants by the State Board of Health. Only five states are requiring monthly reports, namely, West Virginia, Michigan, Kansas, New Jersey and Ohio. Only one is requiring licensed operators, namely, New Jersey.

The impression from reading these letters is that the general situation is very unsatisfactory. For instance, in the third annual report of the Department of Public Health of the State of Illinois for the period from July 1, 1919, to June 30, 1920, on page 63, the following statement occurs:

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‡Harrington Emerson: Long Hours and Low Pay: Short Hours and High Pay. Business Crucible, July-August, 1921, p. 5.

†Francis E. Daniels: Operation of Sewage Disposal Plants, page 1.

(To be printed on a postal card)

WEEKLY OPERATION REPORT OF THE SEWAGE TREATMENT PLANT

At .... For the Week Ending........................... Submitted by ....

	Sewage by-passed	Counter		Tanks...... (Cameron or Imhoff				Filters .... (Sand, Sprinkling or Contact)		Outlet into (Name of creek, river etc.)	Hours spent at plant
				Sludge		Settling solids					
Day	Hours	Reading	Time	Depth	Removed	Inf	Eff.	Condition	Effluent Stability	Stability	
	1	2	3	4	5	6	7	8	9	10	11
M.											
T.											
W.											
T.											
F.											
S.											

12. Remarks ....

WHAT TO RECORD (To be placed on the left half of the front side of the postal card.

Col. No.

1. Length of time in hours sewage was bypassed. Under remarks state reason.
2. Reading of counter in siphon chamber.
3. Exact time at which reading is taken.
4. Measure depth of sludge in tanks at several points and record average depth.
5. Cubic feet of sludge run out, computed from dimensions of sludge bed.
6. Find c.c. of settling solids in 1 hour from influent. See directions for tests.
7. Find c.c. of settling solids in 1 hour from effluent. See directions for tests.
8. Condition as to surface mat, pooling, evenness of distribution of sewage, etc.
9. Number of days' retention of blue color. See directions for tests.
10. Collect sample about 100 feet below outlet and record days' retention of blue color.
11. Record the number of hours spent in work at the plant.
12. Under remarks state any work done not included in columns, 1-11, such as removal of sludge from sludge bed, etc.

> "Experience has shown that there is a strong tendency among municipalities to neglect the operation of sewage treatment plants. It is a common, fallacious idea that sewage treatment works require little or no attention, and consequently, they are neglected until objectionable conditions prevail because of odors from the plant or because of stream pollution. Some sewage treatment plants have been so neglected that they have become permanently damaged and can be put back into operating condition only at considerable expense."

A SUGGESTED WAY OUT

The way out from this inefficiency and this waste of investment in sewage treatment plants will consist of three steps, each of which, though perhaps difficult to take, is necessary if a suitable return is to be made upon the large investments now required in sewage treatment plants.

In the first place it is believed that the State Board of Health should require the operator of every sewage treatment plant in the state to render a weekly report of daily operation. A form for such a weekly report is suggested herewith. This form can be printed upon one side of an ordinary size postal card, and when filled out at the end of each week, mailed to the sanitary engineer of the State Board of Health. On the address side of the post card should be printed the address of the sanitary engineer of the State Board of Health, and then upon the left half of the front side can be printed certain directions as to what to record in each column.

It is believed that there are many advantages to be secured by requiring a weekly, rather than a monthly report from Iowa plants. For instance, the report card for a week is small enough so that it may be carried in the pocket of the operator, and filled out on the job when the readings and tests are made. Furthermore, the weekly report will aid in securing daily visits to the plants, and prompt knowledge by the sanitary engineer of the State Board of Health of neglect.

While the suggested form does not go much into detail, it does contain sufficient facts so that the sanitary engineer of the State Board of Health should know when plants are being operated properly. The facts called for are easily obtained. For instance, in Column 1 the number of hours sewage is bypassed on any given day, and the reason for it, should be given in order that the state sanitary engineer may know just how much use is being made of the plant. The writer recently visited an expensive sewage treatment plant at which the sewage had been bypassed for a years' time, due to complete neglect on the part of the city authorities. A threatened law suit alone was able to get the plant put back again into operation, and then, naturally, at considerable expense.

The counter contemplated in columns 2 and 3, is one of the simple devices now on the market, similar to that manufactured by the Pacific Flush-Tank Company, and sold at a cost of $5.

The depth of sludge in the tanks, columns 4 and 5, is an important matter, especially at this season of the year when it must be ascertained whether or not there is enough room in the sludge compartments for the winter's sludge. The tests for settling solids in the influent and the effluent, columns 6 and 7, are simple to make. Imhoff conical settling glasses are used. One glass is filled with the sewage as it enters the tank, and another with sewage as it leaves the tank. At the end of one or of two hours the cubic centimeters of settling solids at the bottoms of the glasses may be read directly from the graduations on the glasses. The average removal of settling solids by Imhoff tanks as shown by these settling glasses, is about 95 per cent.

The condition of the filters, column 8, is of course, an important part of the report, since on the average two-thirds of the organic matter in sewage is in solution, and therefore, must be oxidized by the action of the filters. The test for stability of the effluent, column 9, is very easily made. A sample of the effluent may be caught in a 4-ounce bottle, to which is added the proper proportion of methylene blue, by using an ordinary pipetite. The number of days' retention of blue color, when the sample is kept at room temperature, is then noted. If the sample retains its blue color for four days, no nuisance will be caused by discharging it into an ordinary creek or ditch.

The test for stability of the mixed creek or river water and sewage effluent, column 10, is an important test in case the landowners below the plant should sue the city for damages due to supposed putrescibility of the creek water caused by the addition of sewage. The test is made in a manner similar to that upon the effluent from the filters. Of course full directions for these tests should be made in a small pamphlet to be issued by the State Board of Health.

Naturally column 11, "hours spent at the plant," is one of the most important columns of the report.

Under "remarks," at the bottom of the card, should be stated any work done that is not included in columns 1 to 11, such as removal of sludge from the sludge beds, etc.

The second step in the process of placing the operation of treatment plants upon a more scientific basis would be the appointment of a competent sanitary engineer in charge of a plant whenever the weekly operation report, or whenever a personal inspection on the part of the sanitary engineer of the State Board of Health, shows that the plant is not being operated properly. It would not be necessary for the sanitary engineer to devote much time to a given plant. By having copies of the weekly reports sent directly to him as well as to the sanitary engineer of the State Board of Health, and by giving the necessary instructions to the local attendant, proper operation of the plant could be obtained at all seasons of the year.

It is interesting to note that this recommendation was made in the Third Annual Report of the Department of Health of the State of Illinois already referred to. On page 64 of this Report it is recommended:

> "The burden of constant control of sewage treatment plants should not be borne by the state, but rather the municipalities should retain competent engineers to make sufficiently frequent examinations to insure proper operation. The state should, of course, supplement the work of these engineers and employees by periodic inspections of the plants at reasonable intervals, to check their operation and give advice which can often be based upon the experiences at other treatment plants."

The third step in securing better operation of Iowa plants would include the preparation of a set of general directions for the operation of the various parts of sewage treatment plants of all types. This set of directions should contain drawings and photographs of the proper tools to be used in carrying out the directions. A description of the tests necessary, such as those for settling solids and stability, should be carefully explained. Furthermore, the State Board of Health might assist in obtaining the necessary equipment for making the tests by furnishing complete lists, stating where the equipment may be purchased, and its cost.

CONCLUSION

The fact that much of the investment in Iowa sewage treatment plants is now a waste of money is to be regretted. Usually the fault is not with the design of the plants, or with the bacteria upon which the transformation of organic matter depends. The reason for this situation is due principally to the human factors involved in the operation of these plants. It is believed that the three steps of requiring weekly reports, operation under charge of competent sanitary engineers where necessary, and the preparation of a carefully prepared set of directions will do much to remedy the present deplorable state of affairs. Of course all this pre-supposes that the Iowa State Board of Health will have funds to finance this extension of its work.

The final question, therefore, again involves the human equation: "Will the state pay the price?" We must not allow ourselves to forget that well-known axiom in the science of public health, propounded by the New York State Department of Health:

> "Public health is purchaseable. Within natural limitations any community can determine its own death rate."

Trench Machine Excavates 47,880 Cubic Yards Per Day

A ditch 20 feet deep and 108 inches wide has been excavated in Muncie, Ind., at the rate of 266 linear feet per 10- hour day by the Harris-Andrews-Henderson Co., Youngstown, Ohio. The work was done with an Austin Machinery Corp., trenching machine with multipedal traction operated by an 100-h.p. gasoline engine at a cost of $25.00 per 10-hour day; or at the rate of about $0.0052 per cubic foot.

The machine will dig from 27 to 54 inches in width and to a little more than 20 feet in depth at a speed of about 1 linear foot per minute. In this case the trench was excavated with two cuts each 8 feet 3 inches wide at the rate of 80 cubic feet of earth per minute. In shifting from one cut to the other the boom was raised, the machine moved forward and then back again in approximately 2 minutes.

The spoil was deposited by the automatic conveyor on one side of the trench, leaving the other side free for the delivery, storing and handling of the precast concrete sewer pipe that was installed in the trench. As fast as the second cut was completed by the machine the sides of the trench were sheeted with square edge vertical planks, braced by two or three horizontal sets of adjustable pipe struts engaging two lines of rangers.

Pulverizing House Refuse

An English plant inspected by municipal engineers, and comparisons with existing destructors. Disposal of destructor clinker difficult.

On October 21st the Institution of Municipal and County Engineers of England met at Hampstead and there inspected a pulverizer plant for the conversion of house refuse into fertilizer. The plant comprises two refuse manipulators, each capable of pulverizing about 20 tons of house refuse a day, elevator conveyors for discharging material into railway trucks, counter shafts, motors and other necessary electrical equipment. Each manipulator is operated by a 50 h.p. electric motor, and the elevator conveyor by a 5 h.p. motor. The cost of the plant, electrical equipment and adaptation of buildings, including the pit and the machinery foundations, amounted to 5,000 pounds, the contract being made last year when prices of materials and labor were at the peak.

It is reported that the net cost for conversion of refuse at this plant, including all labor and other operating charges and interest and depreciation, is estimated at about 6 shillings a ton for the current financial year. The plant, with its conversion of 40 tons a day, treats only about half the refuse of the borough and at the present time the authorities are paying about 13 shillings per ton for disposing of the remainder of the untreated refuse to be dumped in the country. A contractor pays the council 9 pence the first year, 1 shilling 6 pence the second year and 2 shillings the third year per ton for the crushed refuse placed in a truck at the plant, the contractor paying all transportation and other charges and finding customers for the fertilizer. It is reported that he has disposed of all the material since last April without difficulty.

Only three men are employed at the plant by the borough, although others were present employed by the contractor, who had the privilege of salvaging the refuse. The refuse is deodorized in passing through the pulverizers. No storage or accumulation is permitted and the odor from the works was said by O. E. Winter to be less than that from any refuse destructor he had ever visited. He suggested that a small furnace would be useful for destroying infected mattresses and some other materials. Hampstead authorities had contemplated a complete salvaging scheme and plans for the same had been prepared three years ago, but the cost was seen to be so excessive that is was abandoned.

The engineers saw the refuse being unloaded from electric refuse collecting trucks, conveyed to the machines, pulverized, and in a very few minutes automatically loaded into railway cars. Referring to the plant afterwards, one of the members stated that, although he had sniffed the converted material and endeavored to find a nuisance at the works, he found no objectionable smell anywhere. Another member stated that his municipality, Sutton, had a pulverizing plant and that he noticed that, while flies were abundant in the house refuse before treatment, there were none when it left the pulverizers.

Some of the members present made comparisons with destructors used in their own municipalities. W. A. Grieves of Sutton stated his opinion that refuse destructors would not be erected for town refuse in the future, the chief difficulty being that of getting rid of the clinker resulting from the incineration. Capt. Wilkinson, of Tottenham, said that the Hampstead process was much more sanitary than any destructor process he had ever come across, including his own. The net cost of destruction at the Tottenham destructor was 10 shillings. Norman Scorgie, of Hackney, said that the clinker from their destructor was a serious difficulty. They had proposed setting up a plant for making flags or slabs, but found that the capital and labor gave a cost higher than that for making the same slabs of crushed granite.

Rainfall and the San Antonio Flood

Some rainfall and run-off records relative to the flood. Total run-off percentage not high.

In the issue of October 22nd, Public Works gave some information concerning the flood that occurred in San Antonio on September 9th and 10th of this year. No official data concerning rainfall or run-off were available at that time and some startling and almost unbelievable estimates of precipitation were made. In a paper presented before the American Society of Civil Engineers by C. T. Bartlett, a consulting engineer of San Antonio, more definite and reliable data have been given, from which the following statements are obtained.

Prior to the storm the country in the vicinity of San Antonio had been quite dry and practically no water was flowing in the several creeks. In fact Alazan and Apache creeks are dry arroyos. The soaking rain of September 8th entirely disappeared and no run-off occurred, and very little from the rain of the 9th until the electrical storm at 6 p. m. Even this storm did not produce as high a percentage of run-off as would have been expected from an eastern shed, owing to the continued absorption in the soil in the water shed and also by the rapid absorption of that which overflowed the banks of the streams within and just above the city limits.

According to the rainfall records that were available, about one-third of which were secured by standard rain gages and one quarter by measurements in straight-sided cans taken by farmers who keep more or less regular records, "the greatest intensities in the San Antonio storm were between 6 p. m. and 11:30 p. m. During these 5½ hours the rainfall ranged from 1.56 inches at the San Antonio weather bureau to 3.5 inches, 4.5 inches, 6.2 inches and possibly as high as 15 inches at various points. The average on the water shed for this 5½ hours has been placed at 6.5 inches.

"The Engineering Corps of the writer's firm has made a hydrographic survey, as careful as circumstances permitted, of the slopes and areas of the flood crest at various points. It appears that ½ mile above the city limits, the flood peak in the Olmos was between 31,000 sec-ft. as a minimum, and 39,000 sec-ft. as a maximum, from 32.4 sq. miles. This represents from 960 to 1,200 sec-ft. per square mile. The peak discharge at the center of the city is estimated at 23,700 sec-ft., or 580 sec-ft. per square mile from 41 sq. miles. Below the center of the city, 1½ miles, the crest is estimated at 15,000 sec-ft., or 333 sec-ft. per square mile from 45 sq. miles.

"One feature of the flood that will be difficult for Eastern engineers to understand is the comparatively small run-off. Above the city, the Olmos was not out of its banks more than six hours, the crest falling almost immediately. The flow increased from about 4,000 to 35,000 sec-ft. and fell again to 4,000 sec-ft. in six hours. At the center of the city, the flow ranged from 4,000 to 23,700 sec-ft. and back to 4,000 sec-ft., in about eleven hours.

"From unofficial gaugings taken by the U. S. Geological Survey, on the day following the flood, and by gaugings of the water-stage register, and from other data, a rough computation has been made of the run-off for the storm for a period of 7 days, which indicates that it did not exceed 10,000 acre-ft. from an area of 42 sq. miles above the station. All the storm flow had practically run off within the period of one week.

"This estimated run-off of 10,000 acre-ft. is 35.4% of the depth of rainfall for the entire storm. However, by far the greater portion of this run-off was from 32.4 sq. miles above the city. It is probable, in fact, that the run-off was as great from the upper basin as from the entire basin, the absorption of flood-waters by gravel beds in the lower valley probably amounting to as much as the run-off from the lighter rain on the lower 9 sq. miles within the city.

"Assuming that the run-off from the upper basin of 32.4 sq. miles was as great as at South Alamo Street, 5 miles down stream, that is, 10,000 acre-ft., according to the estimate, the run-off from the Olmos basin was about 42 per cent. Regarding the Thursday night and Friday rains, amounting to an average of 6.5 in., as producing only 10 per cent of the actual run-off, there would have occurred an average run-off of not more than 70 per cent from the 5.5-hour rain of Friday night falling on pre-saturated ground and amounting to from 3.5 to 15 in.

The flood peak on the Upper San Pedro Creek was not excessive either from the run-off of the earlier local storm, or from the later overflow from the river. The maximum discharge was possibly 1,500 sec-ft. from 2 sq. miles.

"On the Alazan Creek, the water-shed of which is ideal for a quick flood concentration and on which a small earth dam was washed out, the peak flow was approximately 330,00 sec-ft. from 16.9 sq. miles, or at a rate of 1,950 sec-ft. per square mile.

"The Apache Creek is estimated to have flowed at a rate of 15,500 sec-ft. from 22 sq. miles, or 704 sec-ft. per square mile."

PUBLIC WORKS

Published Weekly
at 243 W. 39th St., New York, N. Y.

S. W. HUME, President J. T. MORRIS, Treasurer

Subscription Rates
United States and Possessions, Mexico and Cuba $3.00 year
All other countries .... $4.00 year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Byrant 9591
Western office: Monadnock Block, Chicago
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Operating Sewage Treatment Plants

In the operation of sewage treatment plants "the bacteria are to be depended upon to do their work if given a chance. The human factor, however, generally fails to function properly, with the costly result that the plant fails to perform its duty."

Thus says Prof. John H. Dunlap, of the University of Iowa, in discussing the general state of sewage purification in the United States. As the result of inquiries addressed to the state boards of health, he learned that New Jersey alone required operators of sewage treatment plants to hold state licenses; that only five states require monthly reports from such operators and that only eighteen require the approval of plans for sewage treatment plants by the state board of health.

There are abundant reasons why such plants should be constructed and operated under state or federal supervision. Until there is such supervision, it can not be expected that there will be much improvement in a condition that is really serious, in that plants in which the taxpayers have invested millions of dollars are, in the great majority of cases, turned over to the charge of men both ignorant of how they should be operated and indifferent as to their success.

City Engineers and Consulting Specialists

A city engineer has to know something—or act as though he knew something—about more phases of engineering than perhaps any other class of engineers. He must construct sewers, bridges, pavements; collect and dispose of street and domestic refuse; perhaps operate sewage treatment and water purification plants, with their chemical and biological features; and must satisfy the citizens in general, and the powers that be in particular, that he is "onto his job" in these and a dozen other lines.

And it is greatly to the credit of our municipal engineers that he generally is, and the engineering features of United States cities compare favorably with those of any other country. But in any growing city there come times when specialized knowledge along one line or another is necessary or highly desirable—as for designing new sewarage or water supply systems or solving unusual problems in existing ones; deciding on a paving program, or one for the disposal of municipal refuse; preparing a city plan for future development, etc. And unless he is an exceptional man, a city engineer cannot find time from all his regular duties to become a specialist in any one of these branches, and only a super-man could be a thoroughly informed specialist in all of them.

When such specialized knowledge is required, therefore, it is no discredit to a city engineer if he ask that a specialist be employed to advise him; in fact, the discredit would lie in his being ready to risk the expenditure of the taxpayers' money without taking such advice. In case such expenditure is to be large, he should obtain such advice even though himself perfectly competent to design the work, considering it as a factor of safety, on the general principle that "two heads are better than one."

In the professions of medicine and law this is well recognized, and no imoprtant case is considered properly handled unless a consulting physician be called in or more than one lawyer be employed upon it; and the better class of general medical practitioners are continually referring their patients to eye specialists, nerve specialists, etc.

There would seem to be little question that city councilmen or others to whom the matter of employing a consultant must be referred, or any other intelligent citizen, will readily recognize the logic of the above if it is properly presented to them, and appreciate the broadminded attitude of their city engineer in asking that he be authorized to obtain advice with a view to making it more certain that the work contemplated will be creditable to them and to him. But to have the work prove a partial or total failure because of neglect of the engineer to request advice, may cause a setback to his advancement in the profession; and justly so, for good judgment is as necessary in this respect as in the purely engineering functions of designing and constructing public works.

Hydraulic Fill Dam Completed

The Lockington Dam, 6,600 feet high, was built in 3½ years at a total cost of $1,280,000 with 1,000,000 yards of hydraulic and drag line fill placed for drainage, 75 and 23 cents per yard respectively.

This dam controls the flood run-off from a drainage area of 255 square miles and by impounding 63,000 acre-feet of water, reduces the maximum flood discharge from 33,000 to 8,600 cubic feet per second, retarding the flow for 7 days necessary to empty the full 3,600-acre basin. About 3,500 feet of the dam consists of a low dike built in 1919 with a large dragline excavator, narrow gage track, locomotive and dump cars, at a cost of 23 cents per yard.

The main part of the dam, across Lorraine Creek valley, consists of a high earth dam and a massive concrete retaining wall outlet structure. The lower part of the high dam was built in 1919 with the aid of a Lidgerwood class K dragline excavator. The remainder of the embankment was constructed by the hydraulic fill process of which it affords a notable example.

Considerable preliminary time and expense were involved in building a labor camp; construction of a railroad siding, a power transmission line for electric current which operated most of the plant, a diversion dam to increase the water supply from a leader canal, an emergency pumping plant to insure adequate water supply for the City of Piqua; and in sand and gravel washing and screening plant and the installation of a large amount of heavy construction plant and equipment.

Material for the embankment was excavated by hydraulic giants in a 2,000- x 2,000-foot hillside borrow pit adjacent to the end of the main portion of the dam. Two 8-inch and one 14-inch electrically driven centrifugal pumps operated in various combinations in series and in parallel, supplied the two hydraulic giants, having changeable nozzles from 2½ to 5 inches in diameter, with water at from 40 to 175 pounds pressure according to the character of the material encountered.

Water from a feeder ditch constructed for the purpose around the upper edge of the borrow pit was used to sluice the paving material to a sump near the dam, whence it was pumped to the embankment. The giants required a supply of 10 second feet and about an equal amount that was used for sluicing was kept in circulation by pumps that returned it from the sump to the ditch, thus reducing the total consumption for which there was only a limited supply. The sluices were inclined from 2½ to 5 per cent.

At the sump two 14- and 15-inch United Iron Works, and American Manganese dredge pumps, direct connected to Allis-Chalmers motors, were installed and pumped the excavated material through suction pipes of from 12 to 15 feet lift, and delivered it to each side of the dam through a separate special 12-inch pipe made by the American Rolling Mills and operated under a maximum head of 115 feet. The solid material was distributed and classified by gravity and sedimentation to forman embankment with coarse materials on the outer slopes and very fine impervious material for the core.

The outlet structure is 82 feet high, 140 feet wide and 525 feet long and contains 32,000 cubic yards of concrete made with aggregate provided from the near by Dull sand washing plant. The concrete was delivered from the mixer in bottom dump buckets on narrow gage flat cars hauled by a gasoline locomotive and handled by two 120-foot guy derricks with 105-foot booms that also shifted the moveable forms.

The cost of the hydraulic fill was 75 cents per cubic yard, common labor receiving from 36 cents to 48 cents per hour and good carpenters from 65 to 80 cents. Most of the cement was purchased for $3.00 per barrel, and run-of-mine coal cost from $4.19 to $4.65 per ton. The first shovel full of earth was excavated March 1, 1918, pumping the hydraulic fill material was commenced June 12, 1919, the concrete work was completed May 27, 1919, and the hydraulic fill was finished August 20, 1921. The work was done by the Miami Conservancy District, Charles H. Paul, Chief Engineer.

Building Zone Ordinance Unconstitutional

The building zone ordinance of Dallas, Texas, which prohibits the construction of any business houses within what the ordinances designates as a residence district, except with the consent of three-quarters of the property owners of the district and approval of the building inspector as to the design of the proposed structure, has been held to be unconstitutional and void by the state supreme court.

The argument that the ordinance was for the protection of public health or public safety was held by the judge to be an idle contention, as was also the plea that a business building would impair the public comfort or be injurious to the public welfare. The judge declared that the ordinance was merely "to satisfy a sentiment against the mere presence of a store in a residence part of the city." He claimed that the law of the land would not permit a man to be deprived of the lawful use of his property because his tastes were not in accord with those of his neighbors. "Under the common law and in a free country a man has an unqualified right to erect upon his land non-hazardous buildings in keeping with his own taste and according to his own convenience and means, without regard to whether they conform in size or appearance to other structures in the same vicinity, even though they may tend to depreciate the value of surrounding improved or unimproved property."

This judgment was brought about by a suit which has continued since 1916, when a citizen applied to the city for a permit to erect a brick business house in a residence district. The city has no recourse except to seek a new hearing before the supreme court.

Recent Legal Decisions

CITY'S POWER TO CONSTRUCT WATER RESERVOIR IN PARK

In a suit to enjoin the city of Seattle from constructing, at a selected site in Volunteer Park, a reservoir for the storage of water for the use of the city and its inhabitants, the Washington Supreme Court holds, Ferry v. City of Seattle, 200 Pac. 336, that, the land having been purchased by the city, which took title in fee simple, the fact that the city made expenditures and used the land for park purposes does not prevent it from using part of the park for a water reservoir on the theory of an irrevocable dedication for park purposes. And the proposed reservoir would not be enjoined as a nuisance merely because of the possibility of its construction on a hill, causing a subsidence of the ground, or the escape of water, without evidence that these would be the necessary or probable results. In such cases the test is not what may possibly occur, but what may be reasonably expected to happen.

EXTENSION OF WATER WORKS SYSTEM TO EXCEED CONSTITUTIONAL LIMITATION NOT MANDATORY

Wisconsin St. 1919, par. 927-16, in so far as it authorizes cities to acquire and construct public utilities and issue bonds payable only from the revenue thereof and secured by mortgage liens thereon, does not create a corporate indebtedness within the constitutional limitation. But the Wisconsin Supreme Court holds, State v. City of Portage, 184 N. W. 376, that a city cannot be coerced into complying with an order of the Railroad Commission to make improvements in its water works system pursuant to like provisions of that statute relative to extensions, additions and improvements, if the city would by so doing exceed its constitutional indebtedness. The effect of compliance with such order would be to mortgage the city's existing water works to secure the payment of a corporate debt incurred after the works were acquired by the city.

PAVING RESOLUTION UPHELD—EVIDENCE THAT THE WORK WAS UNDERTAKEN WHEN PRICES WERE HIGHEST EXCLUDED

A resolution to pave, passed by a city council on March 19, 1920, was approved by the mayor on March 23, 1920. The law forbids the mayor to sign such a resolution within four days after its presentation to him, but provides that, if not returned within ten days after presentation, it shall take effect without being approved. The Minnesota Supreme Court holds, Hamre v. City of Thief River Falls, 184 N. W. 225, that the approval was nugatory, and the resolution could not be considered as returned, either as approved or vetoed, and it went into effect as for failure of the mayor to act. The trial court rightly excluded proof offered that the improvement was undertaken when prices therefor were the highest. There was no averment or offer of proof that the city council members were actuated by improper motives or exercised their judgment arbitrarily.

MUNICIPALITY HELD NOT LIABLE FOR UNEXPECTED KILLING OF FISH IN FISH POND ON CLEANING WATER RESERVOIR

The Utah Supreme Court holds, Lund v. Salt Lake County, 200 Pac. 310, that the county was not liable for the destruction of fish in the plaintiff's fish ponds from impure water allowed to flow therein from the county's water supply reservoir after it had been flushed, on the theory of a nuisance, the injury being an unexpected result of the cleaning of the reservoir. And no recovery could be had as for property taken or damaged for public use without just compensation, the damages not being the direct consequence of the exercise of the right of eminent domain.

LIMITATION OF INDEBTEDNESS

The Alabama Supreme Court holds, Town of Camden v. Fairbanks, Morse & Co., 89 So. 456, that section 225 of the Alabama Constitution, 1901, limiting the indebtedness of cities and towns to 5 per cent of the assessed value, but permitting an additional indebtedness of 3 per cent for construction or purchase of water works, etc., is not violated by a contract for the purchase by a municipality of machinery for use as part of its water works.

CITY NOT LIABLE TO EMPLOYEE OF RAILROAD OPERATING WITHOUT FRANCHISE BY VIOLATION OF LIGHT POLE ORDER

The fact that a city erects an electric light pole less than eight feet from the centre line of a railroad track, in violation of an order of the State Railroad Commission, does not render it guilty of negligence as respects the rights of a brakeman injured by coming in contact with the pole while climbing the side of a box car extending over the line of the street, where the railroad was operating in the street without a franchise. There cannot be neglect without the existence of a corresponding duty.—Sincerney v. City of Los Angeles (Cal. App.), 200 Pac. 380.

TO RESTRAIN COLLECTION OF SIDEWALK TAX, THE PLAINTIFF MUST SHOW PROPERTY INTEREST

In order to entitle a plaintiff to temporary injunction restraining the collection of a sidewalk tax, the Idaho Supreme Court holds, Crane v. City of Harrison, 200 Pac. 892, that the complainant must show some present interest in property or liability for payment of tax.

CONTRIBUTOR NEGLIGENCE IN STEPPING ON SEWER INLET-COVER

In an action by a pedestrian against a city for injuries sustained by stepping on an iron cover over a sewer inlet, while passing from the cartway of a street to the sidewalk, it was held, in Kirshner v. Philadelphia, 75 Pa. Superior Ct. 231, that judgment was properly entered for the defendant city where it appeared that the accident happened in broad daylight, that the plaintiff was familiar with the location, and that he admitted he had not looked at the inlet-cover as he stepped on it, and there was also evidence that the cover was tilted on one side, which the plaintiff could have seen if he had looked.

NEWS OF THE SOCIETIES

Dec. 13—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary, N. L. Nussbaumer 80 W. Genesee Street, Buffalo.

Dec. 13-14 — EASTERN PAVING BRICK MANUFACTURERS ASSOCIATION. Annual meeting. Pennyslvania Hotel, New York City.

Dec. 14 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' building, New York City.

Dec. 15—ENGINEERS' CLUB OF CINCINNATI. Cincinnati.

Dec. 15 — BRIDGEPORT BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Hotel Stratford. Secretary Arthur R. Parker, Watrous Engineering Co., Bridgeport.

Dec. 15 — MERIDEN BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Home Club. Sec. E. W. Carruth, Aeolian Co., Meriden.

Dec. 15—TOLEDO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Loring Freed, Atlas Chemical Co.

Dec. 16 — ASSOCIATED PENNSYLVANIA HIGHWAY CONTRACTORS. Second annual meeting. Joint meeting with HIGHWAY CONSTRUCTION INDUSTRY OF PENNSYLVANIA, Penn-Harris Hotel, Harrisburg. Pa.

Dec. 16—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, G. I. Rhodes, 115 Broadway, N. Y. C.

Dec. 20—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce. Secretary, Prof. W. H. Kavanaugh Un. of Penn.

Dec. 22-23—KANSAS ENGINEERING SOCIETY. Annual meeting. Hutchinson, Kan. Secretary, J. M. Averill, Topeka.

Dec. 27-30—AMERICAN ECONOMIC ASSOCIATION. Pittsburgh, Pa.

Dec. 28-29 — AMERICAN ASSOCIA-FOR LABOR LEGISLATION. Fifteenth Annual Meeting Pittsburg. Frederick MacKenzie, Director of Publicity, 131 E 23rd St., New York.

Dec., 27-31 — AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, SMITHSONIAN INSTITUTE, Washington, D. C. Toronto, Canada.

Jan. 4-14 — CLEVELAND, OHIO, BUILDING EXPOSITION. Municipal auditorium, Cleveland, Ohio.

Jan. 5-6 — AMERICAN ENGINEERING COUNCIL, FEDERATED AMERICAN ENGINEERING SOCIETIES. Annual meeting, Washington, D. C.

Jan. 17-19 — IOWA ENGINEERING SOCIETY. 34th annual meeting. Sioux City. Secretary—Lloyd A. Canfield, Des Moines, Ia.

Jan. 17-19—ASSOCIATED GENERAL CONTRACTORS. 3rd annual meeting. Hotel Winton, Cleveland Ohio.

Jan. 17-20—ASSOCIATION OF CANADIAN BUILDING AND CONSTRUCTION INDUSTRIES. 4th annual conference. Royal Connaught Hotel, Hamilton.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Jan. 18-19—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. New York City.

Jan. 27 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Bldg., New York City. Secretary—G. I. Rhodes, 115 Broadway, New York City.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Convention Cleveland. Secretary Harvey Whipple, 814 New Secretary Harvey Whipple, 814 New Telegraph Building, Detroit, Mich

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING, 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' building, New York City.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention Curtis Hotel, Minneapolis.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATER-WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

AMERICAN ASSOCIATION OF ENGINEERS

At the quarterly meeting of the Board of Directors of the American Association of Engineers in Chicago, November 18 and 19, 1921, steps were taken to push construction and public service activities immediately through the 220 local units of the association. The meeting decided that the local organizations of the Association should stimulate construction throughout the country, especially in municipalities, in accordance with the suggestions and plans of the National Employment Conference held recently in Washington through active cooperation with municipal, federal, and state authorities. Similar action was also directed to the end that municipal engineering service be improved through an educational campaign for:

1. More certain tenure of office.
2. Having technical engineering work supervised by engineers.
3. Putting compensation on a basis of qualifications and service rendered.
4. Insisting that only the highest grade of engineering service be accepted.
5. Extensive cooperation with local civic organizations.
6. Encouraging engineers to prepare popular articles about municipal work such as paving, sewerage, sewerage disposal, sanitation, water supply, city lighting and city planning.

The point was emphasized that this educational work should be more for the general public and not so much for engineers.

Charters were granted to three new chapters: Greensboro, N. C., Vanderbilt University, and Mississippi Agricultural and Mechanical College. To date 800 new student members have joined the Association this fall. In the engineering schools of the University of Southern California, University of Arizona, and New Mexico State College 100 percent of all the engineering students are members of the American Association of Engineers.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The meetings of December 7 and 8, 1921, were devoted to a discussion of the Tentative Specifications for Concrete and Reinforced Concrete contained in the Progress Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, published in "proceedings" for August, 1921. There were six sessions, at which the portions of the Report considered tentatively were:

Water-Proofing and Protective Treatment; Surface Finish; Depositing Concrete; Forms; Details of Construction; Design; Discussion of Design and Details of Construction; General Discussion of the Tentative Specifications for Concrete and Reinforced Concrete and of the Scope of the Joint Committee's Work; Quality of Concrete; Materials, and Proportioning and Mixing Concrete.

AMERICAN ASSOCIATION FOR LABOR LEGISLATION

The Fifteenth Annual Meeting is to be held at the William Penn Hotel, Pittsburgh, Wednesday and Thursday, Dec. 28-29. The most timely subject —*Unemployment, and what should be done about it*— will be handled by several persons who are thoroughly familiar with the subject. Recent important developments in workmen's compensation will also be discussed by leading authorities. The number of persons attending these meetings will be approximately 500, but all sessions are open to the public.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION

The Annual Joint Conference was held at Pittsburgh, Pa., Dec. 6th and 7th. The program included the discussion of specifications at the advance meeting of the Advisory Committee, Dec. 5th. Addresses: "Heavy Clay Products Research and its Relation to Paving Brick Manufacture," by A. V. Bleininger, Homer Laughlin Pottery Co., chairman Technical Committee, Joint Clay Products Research Committee; "The Engineering Point of View Toward the Trade Association," by E. J. Mehren, editor, *Engineering News Record;* "What Trade Associations Are Doing for Their Members," by E. W. McCullough, manager Fabricated Production Dept. U. S. Chamber of Commerce; and "Trade Associations and their Relation to Educational Institutions," by Arthur H. Blanchard, professor of Highway Engineering and Transport, University of Michigan, author and consulting engineer. There was an inspection trip of Allegheny County and Pittsburgh paving.

AMERICAN ROAD BUILDERS ASSO.

At the annual meetin in New York, Nov. 15, the officers elected were: President, H. L. Bowlby, Chief, War Materials Division, Bureau of Public Roads, Washington, D. C. Vice-president, Northeastern District, Charles J. Bennett, State Highway Commissioner of Connecticut, New Haven, Conn.

(Continued on Page 460)

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

COMBINATION HOIST AND AIR COMPRESSOR

The Combination Hoist and Air Compressor manufactured by the Novo Engine Co., was designed especially for bridge, elevated tank, and other steel erection work, within its capacity, and is useful for trench work—the hoist being used to lower and place pipe and the compressor for caulking or light rock drilling.

The outfit consists of a Novo Type TN non-reversible hoist driven by gears from a Novo 15 h. p. engine. A 6 x 6-inch single acting compressor, driven by belt on a clutch pulley, is mounted on an extension of the channel frame.

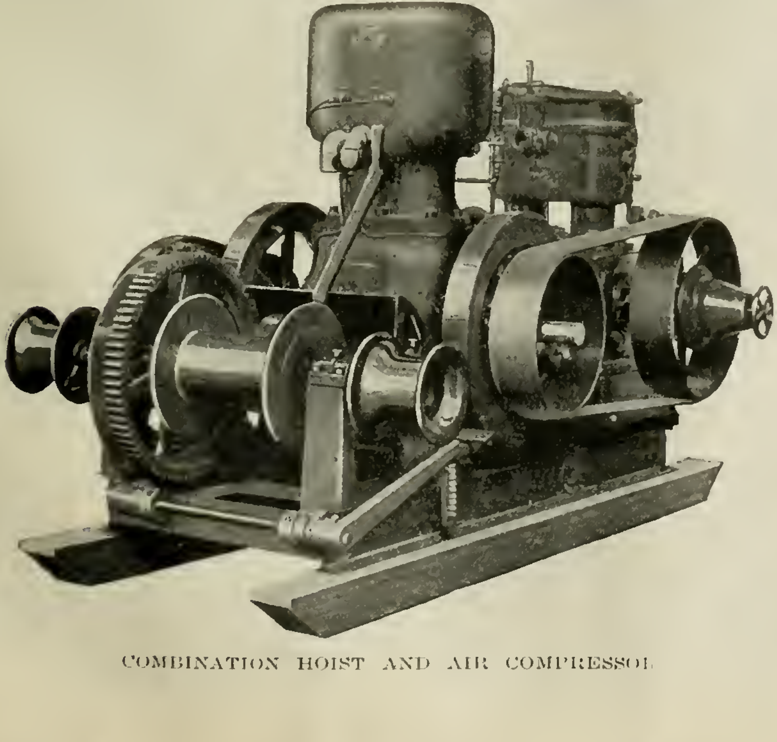
Both hoist and compressor are equipped with friction clutches so that either one may be operated independent of the other. The hoist drum holds 700 feet of ⅛-inch cable and has a niggerhead mounted on each end for handling scaffolding, eercting derrick, etc.

A contracting band friction clutch is mounted on the intermediate shaft for operating the drum or niggerheads and a powerful asbestos-lined foot brake equipped with a ratchet lock is supplied to hold the load.

The compressor has a displacement of 60 feet per minute, which is ample for handling one riveting hammer, caulking, light drilling, reaming, etc. An unloader is provided for cutting out the compressor when the supply of air exceeds the demand is adjustable and entirely automatic in its operation.

The crank case of the compressor is enclosed and is cast separate from the cylinder. The lower part of the crank case is filled with oil and at each revolution of the shaft the connecting rod splashes the oil on all bearings, pins, etc.

Both inlet and discharge valves are made of light sheet steel, seat quickly and quietly without wear on the cylinders and cause the machine to run practically noiseless.



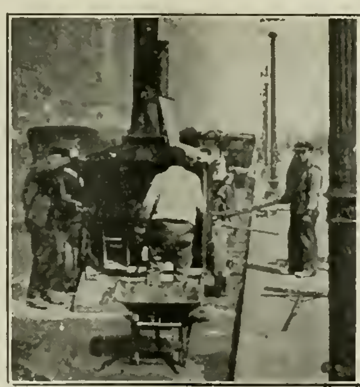
COMBINATION HOIST AND AIR COMPRESSOR

ASPHALT ROAD REPAIR OUTFIT

The road repair outfit manufactured by Littleford Bros. and sold by H. P. Andressen & Co., was designed to provide in a single apparatus everything required for the proper maintenance of modern roads and pavements. It combines in a single unit the heating or melting kettle, two bins for holding sand and stone, a combination mixing pan and tool carrier, a heater for tampers and motors, a coal burning furnace, a coal bin, a cement bin and auxillaries with four men, is compactly mounted on four wheels and arranged to be hauled by a team, a truck or a tractor. The arrangement is such that materials charged into the top of the wagon, are heated and delivered by gravity to the mixing pan in the rear ready for application to the cement.

It is not subject to derangement or breaking and does not require skilled labor for its operation. The 125 gallon asphalt, tar or water kettle is made with welded seams and is provided with two ½-inch drawoff cocks with screened outlets which can be used simultaneously for filling pouring pots, for penetration methods work, and for mixing and to serve the mixing pan for patches. The two 1-yard material bins are surrounded on all sides by hot air flues and are each provided with a 10 x 10-inch outlet controlled by a sliding door.

A steel rest bar in the fire box and notches in the lower edge of the door permit tools to be quickly heated without disturbing the fire. A 51 x 42-inch steel plate mixing pan and tool carrier is hinged to the rear of the wagon at road level and when hauled up by the supporting chains, serves as a carrier for all necessary tools. The 20 x 51-inch furnace, lined with fire brick tiles, has a steel ashpan and renewable sectional grate bars and is arranged with dampers permitting the heat to be concentrated either on the kettle or on the aggregate bins or on both. The two steel smoke stacks are each provided with self looking dampers which control



MAKING BITUMINOUS CONCRETE MIX

FILLING POT WITH MEASURED HOT ASPHALT

COMPLETE OUTFIT STARTING FOR DAY'S WORK

the temperatures. There is a 350-pound coal box with a capacity sufficient for one day's supply and a water-tight cement box with a capacity of 6 bags. The approximate shipping weight of the apparatus is 5,500 pounds.

The Andressen Road Repair Outfit is claimed to be the only one of its kind on the market, can be operated by three or four men, and is especially suitable for small patch work at remote points and for restoration or the repairing of cuts when the large plant is not in operation. It is also suitable for emergency or portland cement concrete work in the winter as it furnishes hot water, hot stone, hot sand and a mixing device in one apparatus.

WAYNE SECTIONAL GRAND STAND

The sectional grandstand manufactured by the Wayne Iron Works is a patented design and construction that has been approved by the Bureau of Building Inspection of Philadelphia. It is made of duplicate light steel sections that permit it to be built up in tiers of any length or height by the addition of standard pieces which may be dowelled securely together without requiring the use of any tools for its erection or removal. There are no small pieces and no bolts, screws, nails or pins. All pieces are interchangeable and fold flat for compact storage or transportation when not in use.

A stand 786 feet long and seven tiers high, was erected in Philadelphia, May 23, 1921, in one working day by a foreman and eight unskilled laborers and was removed by the same men in three hours. It had a seating capacity of 1,000 people and was entirely of steel excepting the wooden board seats.

INDUSTRIAL NOTES

FROM THE AMERICAN ROAD BUILDERS' ASSOCIATION

All of the initial 40,000 square feet of space for the forthcoming Thirteenth National Good Roads Show to be held at the Coliseum, Chicago, Ill., January 16 to 20 next. under the auspices of the American Road Builders' Association, having been reserved by 86 exhibitors at the first drawing in October, the officials in charge have arranged for about 20,000 square feet of additional space to care for a waiting list of about fifty firms not yet accommodated. Arrangements have been made by E. L. Powers, secretary for about 12,000 square feet of space in the balcony of the Coliseum and 8,000 to 10,000 more square feet in two buildings adjoining the Coliseum Annex on the South.

Diagrams showing the new space were sent to prospective exhibitors during the past few days. There were 144 exhibitors at the show last year and the indications are that the number this year will approach nearer the 200 mark. The show last year also broke all records for attendance. It is expected that the attendance this year will be even greater.

At a recent meeting of the directors of the American Road Builders' Association it was decided to open the show with a band concert on the night of January 16. The Twelfth American Good Roads Congress to be held in connection with the show will open on the following day. A meeting of exhibitors was held in Chicago Saturday December 3rd, at which excellent entertainment and program features were planned. Efforts are being made to secure special reduced railroad rates, all points to and from Chicago, for the week of the show. The Central Passenger Association has already granted a rate of one and one-half fare for the round trip throughout its Middle West territory, the reduction being made upon certification by passenger to the railroad agent at the show before the return trip. The indications are that all the other passenger associations will follow suit.

Many new features will be found in the show this year. The U. S. Bureau of Public Roads, will have a mammoth exhibit covering 2,000 square feet of space and will demonstrate, in addition to everything exhibited heretofore, the best methods of choosing sites for new roads, as well as tests of road materials, drainage and subgrades and the effect of impact on both pavements and subgrades

The Osgood Company, of Marion, Ohio, announces the opening of a branch sales office at 1211 Conway Bldg., Chicago, Ill., Telephone No. State 5960, which will be in charge of Arthur B. Sonneborn, as Manager.

On December 15th, the New York Office of the Blaw-Knox Company, will move from the City Investing Building to the Carbide & Carbon Building, 30 East 42nd Street.

(Continued from Page 458)

Vice-president, Southern District, Frank Page, Chairman, North Carolina State Highway Commission, Raleigh, N. C. Vice-president, Central District, A. R. Hirst, State Highway Engineer of Wisconsin, Madison, Wis. Vice-president, Western district, W. W. Crosby, National Park Service, Estes Park, Colo. Secretary, E. L. Powers, Editor, *"Good Roads,"* New York, N. Y. Treasurer, Senator James H. MacDonald, former State Highway Commissioner of Connecticut, New Haven, Conn. Directors: Fred E. Ellis, Fred W. Sarr, R. A. Meeker, W. D. Uhler, S. E. Bradt, F. F. Rogers, George W. Tillson.

Routine business was transacted, a dinner was held at Automobile Club of America, and in the evening there were addresses by the officers and guests.

AMERICAN CONCRETE INSTITUTE

The program of the convention at Cleveland February 13, 14, 15 and 16, 1922, will be spread over nine convention sessions—two sessions a day for three days and three sessions on a fourth day. These will be divided as follows: two sessions for contractor problems—the practical problems on the job; two sessions for concrete products manufacturers; one session on Roads; one session on Houses; one session on Research; two sessions on Engineering Design and Inspection.

The Institute Committees are probably better organized this year to cover thoroughly the work of the concrete field than they have ever been before. While theoretically the A. C. I. has always stood for all development worthy of notice in concrete work, it has perhaps in its later years given more attention to technical and theoretical matters in some lines than to the practical problems of the field, which are as clearly important.

A special Committee on Organization appointed at the time of the last Convention was asked to review the whole field of technical activities of the Institute; to make certain recommendations to the Board of Direction as to the reorganization of old committees and the appointment of new ones, to outline a program for committee work, where committee programs did not already exist and to accomplish the whole thing with special reference to three distinct groups of interest represented in Institute membership, namely: Engineering Design and Inspection, Construction, Products Manufacture. This committee held two all-day meetings March 17 and May 4, and accomplished considerable by correspondence also. It presented its report at a meeting of the Board of Direction May 6, and with only minor modification, the report was adopted as a working program for Institute activities.

NEW ENGLAND ROAD BUILDING ASSOCIATION

The first annual dinner under the auspices of the New England Road Builders' Association will be held at the Hotel Somerset, Commonwealth Avenue, Boston, Mass., on Thursday, December 15, 1921, at 6 o'clock P. M. Frederick Hoitt, secretary, 168 Devonshire Street, Boston. Distinguished guests and some speeches are expected. This affair is open not only to members of the New England Road Builders' Association, but also to all road builders in New England, to material and supply dealers and friends. The cost will be $5 per person.

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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 51 DECEMBER 17, 1921 No. 25

Centrifuges for Dewatering Sludge*

By T. Chalkley Hatton†

Sludge used by farmers in Germany dewatered by filter presses and centrifuges, the latter different from any heretofore used in this country and described in this article.

Every engineer engaged in the study of sewage disposal by modern methods recognizes that the art is divided into two distinct problems—the partial purification of the liquor and the disposal of the sludge—and that the latter is, of the two, the more difficult to satisfactorily solve.

For many years—in fact up to the present—sludges produced by many of the English sewage disposal plants were deposited upon ground and plowed in. After a few seasons of this practice, the tracts of ground set aside for this purpose became sour and unable to digest the organic matter. They were, therefore, abandoned.

The largest sewage disposal plant in England, the Birmingham plant, is now lagooning the sludge, monopolizing a large tract of most excellent ground which could otherwise be used for the production of foodstuffs of which the country stands so greatly in need. This method not only destroys the real value of the ground but constitutes a nuisance to the immediate neighborhood.

To sum up my impressions after a recent visit to many of the sewage disposal plants of England: There was none (except disposal at sea) where the disposal of the sludge was being handled so as to avoid a nuisance. In fact, it was creating a far greater nuisance than the clarification of the sewage, and but little progress appears to have been made since my last visit in 1907.

I had an opportunity to compare the relative advantage of the methods employed in Germany and England.

The sludge problem, my observation showed, was studied with painstaking care and considerable skill by the German engineer. Recognizing that he had a product for which there was a market, he proceeded to make sure of this market by preparing and delivering his product so as to give satisfaction to the ultimate buyer.

The English engineer, on the other hand, starts with the assumption that the English farmer and truck grower will not use sludge in any form, no matter how well prepared and conveniently delivered. He ignores the requirements of his potential customers and produces his sludge in a form best suited to himself. It is to be regretted that the American engineer has adopted the same negative point of view.

Modern agricultural chemistry shows that all sludges produced by sewage disposal plants contain sufficient fertilizer value in the form of nitrates (ammonia and humus) to warrant their use by the farmer or small truck gardener, provided the cost of handling is not too great. That the sludges produced from plain sedimentation may be profitably used by the agriculturist when the wagon haul does not exceed five miles and providing the sludge contains not more than 75 per cent moisture, was demonstrated by the Agricultural Department of the late Imperial German Government as far back as 1912. The German Government from that time on prepared and distributed literature instructing farmers in the most approved ways of using sludge as a fertilizer.

What has been the result? Hamburg, Hanover, Frankfurt-on-the-Main and many other German municipalities are disposing of their sludge to the surrounding communities so effectually as not to have a dozen wagon-loads left on hand any one night. In fact, the demand is so great that each customer is given his own day in the month when he must come for his apportionment, for which he pays a certain sum fixed by the government. While this sum is not sufficient to meet the cost of dewatering the sludge, it defrays at least a part of the expense. More important is the fact that the sludge nuisance is eliminated while the prosperity and productivity of the community are materially advanced.

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*Presented before the Sanitary Engineering Section, American Public Health Association.

†Chief Engineer of Sewerage Commission, Miwaukee, Wis.

Now how has Germany accomplished what none of the rest of the world has been able to achieve?

First, by preparing its product to meet conditions under which the consumer can handle it.

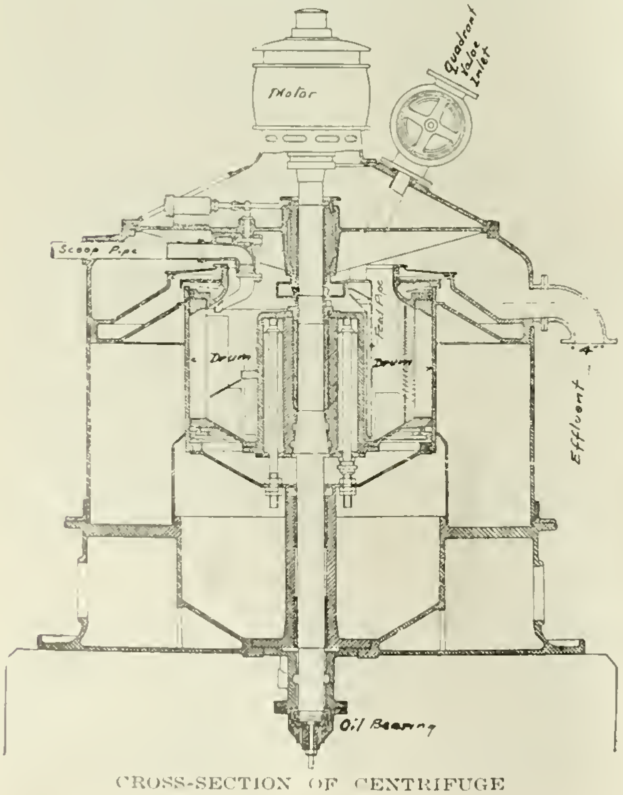
Second, by educating the consumer, through national and local government bureaus as to the value of the product and the best methods of using it.

As a result of these two important services, a market for all the sludges produced has not only been found but is being extended more rapidly than the demand can be met.

That sludge which has been properly prepared need not look far or long for a buyer has been proved by at least one progressive English municipality. The city of Bradford, after extracting the excess grease from its sewage through filter presses, breaks up the cake by means of a disintegrator and thus finds a ready and profitable market for it among the fertilizer manufacturers.

Notwithstanding the fact that Bradford's raw sewage is notoriously offensive, the neighborhood around the disposal works is free from unpleasant odors. This is due in part to the effective methods employed and in still greater part to the prompt shipment of the sludge to the consumer.

The Germans have prepared their sludges by partial dewatering through both filter presses and centrifuges and the sludges so treated are produced mainly from plain precipitation. The filter presses in use are quite similar to the types in common use in America from which about the same results are obtained. The centrifuges, however, are quite different from any the writer has heretofore seen, and are worth a brief description.



CROSS-SECTION OF CENTRIFUGE

The machine is made by the "Hanomag" Works at Hanover-Linden, Germany. It was designed by Dr. ter Meer, director of the Hanomag plant and Mr. George Froboese, his master mechanic. During the war, the American patents became the property of the custodian of enemy property and were purchased by the Barth Engineering and Sanitation Company of New York City, which changed the name of the machine to "Besco-ter-Meer."

Unlike most centrifuges, the machine is continuous and automatic in its operation and is devoid of all screens. It can be set to feed, discharge, post centrifuge and scoop at any cycle or combination without any manual control. It builds up its cake against a solid stationary plate and unloads it by dropping below this plate the depth of the bowl, the cake being thrown out of the bowl by centrifugal force into a chamber equipped with revolving scrapers which remove it to the point of discharge.

Because the machine is of more than passing interest to the sewage disposal engineers and because we have been operating one in the testing station of the city of Milwaukee for six or eight months, the writer has included two cuts of the enlarged machine showing a photograph of the machine as set up (this is not reproduced), and a cross section through the center. The important dimensions are as follows: Inner diameter of drum 44 inches; drop of drum when discharging, 20 inches. Depth of cake chamber to overflow zone, 24 inches. Thickness of cake formed, 9 inches. Operating oil pressure to support shaft drum and motor, 210 pounds per square inch. Total height of machine including motor, 10 feet. Diameter of outer housing, 6½ feet. Weight of machine, approximately 10 tons, R. P. M. 1,000. Main drive motor, 35 h.p. slip ring. Oil pump motor 10 h.p. Automatic control motor, 2 h.p. Inlet valve designed to automatically control rate of feed during cycle.

Average records taken from two disposal plants where these centrifuges have been in use for several years will fairly illustrate the ability of the machine to dewater sludges from plain sedimentation. At the Herrenhausen Sewage Disposal Plant, which treats the sewage from Hanover-Linden, amounting to 40 million gallons daily, plain sedimentation only is carried out for clarification. The time of detention is two hours. Every two days one of the 12 sedimentation tanks is emptied and the precipitated solids, amounting to 70 per cent of the total suspended solids in the raw sewage, is run to sludge storage tanks.

This sludge, containing 96 per cent moisture, passes through a 9 m.m. mesh screen and into one of three 36-inch centrifuges, each of which delivers 11 cubic yards of cake per hour, containing from 72 to 75 per cent moisture, the filtrate being returned to the raw sewage. The cycle of operation is four minutes, which embraces filling, centrifuging and discharging. Each machine requires 25 h.p. motor to operate and one man looks after the operation of all the equipment in the centrifuging house. Screw conveyors carry the cake from the machines to outside the building where it is loaded upon wagons by the farmers and hauled away.

The sewage disposal method in use at Frankfort-on-Main consists of fine screening, three-quarters of an hour detention in sedimentation tanks and dewatering of sludge. Seventy-five per cent of the suspended solids are removed by sedimentation and these are removed from the tanks after about seven days' operation, becoming quite septic before further treatment.

Eight 36-inch centrifuges are installed, each of which operates 1,200 hours per month, producing 15,000 cubic meters of cake with 70 to 75 per cent moisture, or about 16 cubic yards per hour, the filtrate being returned to the raw sewage. Each centrifuge is operated by a 15 h.p. motor. Counting the screen, agitator and oil accumulator, each centrifuge requires 20 h.p. to operate and one skilled laborer looks after all the plant inside the centrifuge house. The sludge is carried from the centrifuges by means of screw conveyors to direct heat dryers where the moisture is reduced to 15 per cent.

During the war, the drying plant was cut out and the sludge cake from the centrifuges has since been conveyed by hand-pushed cars to a dump, from whence it is removed, as fast as deposited, by farmers and truckers who pay four marks per wagon-load containing 2.6 cubic yards.

Compare this extremely sanitary method of disposing of sewage sludge, where no man handles it except to load the partially dried material in wagons, and where it cannot be seen from the time it leaves the sedimentation tank until it reaches the dump cars, with the present unsanitary and highly offensive method used, for instance, in the sewage disposal plant of the city of Baltimore, or, in fact, in any other of the modern plants in this country and England.

It is the writer's opinion that the English and American engineers have failed to grasp the idea that satisfactory sewage disposal is not accomplished by merely treating the liquor so that the effluent shall not produce a nuisance to the body of water into which it is finally discharged. It is no less essential that the sludge produced from such treatment should be so disposed of as to reduce to a minimum the nuisance and danger to workmen engaged at the disposal plant, and to the adjacent neighborhood. If, in doing this, the values contained in the sludge can be conserved, and two blades of grass be made to grow where one is now growing, the common welfare is undoubtedly improved.

The tendency in most disposal plants is to get rid of the sludge in the cheapest manner possible regardless of the temporary or permanent nuisance resulting. Until this tendency is overcome, the disposal of sewage will not prove satisfactory from the public viewpoint.

The writer believes from his experience in operating and viewing the operation of centrifuges in dewatering sewage sludges and water-laden solids in the industries that centrifuges of the proper type can be economically used in a great many disposal plants in this country and in Europe to displace the crude methods now practiced; that centrifuging will prove far more sanitary; that it will dewater the sludges so that they can be easily and profitably handled by the farmer and trucker and will thus create a steady market for all produced. He firmly believes it the province of the Sanitary Engineering Section of the American Public Health Association to put a little "pep" into the Bureau of Soils of the Federal Agricultural Department, with the object of inducing the latter to carry out intelligent growing experiments with sewage sludges from the various types of plants, to publish the results of such experiments and to give these publications proper circulation among those most likely to benefit therefrom.

Dr. Nasmith, of the Toronto Board of Health, Dr. Bartow, late of Urbana, and a few others, have carried out some experiments to show the probable value of activated sludge. All of these experiments, particularly those conducted by Dr. Nasmith, have demonstrated the growing value of the sludge as compared with other fertilizers and the natural soil.

In estimating the cost of centrifuging sludge per capita, the writer would use the Hanover plant as fairly representing what has been done for several years, and applying American prices.

Hanover operates two centrifuges for 10 hours per day. Each machine uses power at the rate 10 k. w. per hour. One skilled laborer is employed inside and one common laborer outside. The population of Hanover is 320,000. At present prices, the two centrifuges and equipment would cost $32,000, which includes tanks, screens, and conveyors. The building should be built for $10,000.00 Estimating 6 per cent for interest and 6 per cent for depreciation, plus $200.00 per machine for minor repairs; three cents per k. w. hour for current; $5.00 for skilled and $4.00 for common labor and 8 hours per day, we have the following costs:

12 per cent on $32,000................	$3,840.00
2 per cent on $10,000 (building).......	200.00
Minor repairs, $200 per machine........	400.00
52560 k. w. hrs. power at 3c..........	1,576.80
313 days' labor at $9.00..............	2,817.00
10 per cent for contingencies..........	883.38
Total annual cost	9,717.18

$\$9,717.18 \div 320,000 = 3c$ per capita.

Experiments have been conducted at the Milwaukee Sewage Testing Station since October, 1920, upon a Besco-ter-Meer 36-inch centrifuge in dewatering activated sludge. The machine, as first delivered, was designed to operate at 900 R. P. M. which did not produce sufficient centrifugal force to produce a cake low enough in moisture to handle satisfactorily. The speed was increased to 1,300 to 1,350 R. P. M. and much better results secured.

Activated sludge has an average specific gravity of 1.005 and is flocculent but the floc is of such a character as to be readily broken up and reduced to very fine particles when violently shaken. It is therefore extremely difficult to dewater by means of any apparatus which destroys the floc.

After somewhat changing the design of the drum so that a more uniform velocity of flow of sludge passing through it could be maintained, we have been able to reduce the moisture from 98 to 83 per cent at a rate of about 4 pounds of wet cake per minute, removing from 70 to 80 per cent of the suspended and settleable solids in the sludge.

This produces a cake which can be easily handled but the filtrate, containing from 20 to 30 per cent of the suspended and settleable solids in the sludge, is very difficult to satisfactorily treat.

If it is run back into the raw sewage, the sludge begins to pyramid until the aeration and sedimentation tanks accumulate more sludge than the plant can handle. Many experiments have been made to overcome this condition but up to the present time none has been successful.

The writer is not yet prepared to state that the centrifuge will or will not successfully dewater activated sludge but he feels sure, after having three types operated at Milwaukee and viewing the results obtained in America and Europe by centrifuges, both in industries and sludge disposal, that there is a need for them in the latter service, especially where sludges from plain sedimentation are to be handled.

In closing this brief paper, there are two points to which I wish to call your particular attention; the *first* is the necessity for the sanitary engineer to give greater study to better methods for disposing of sludges from sewage disposal plants. In considering this phase of the subject, it might be well for the engineer to look into the general question of the conservation of nitrogen produced by sewage sludges and what it means to communities surrounding the place where the sludges are produced. Mr. Kenneth Allen, in his paper on "Nitrogen," published in the *Engineering News Record* of August 25, 1921, p. 311, touches upon this matter and refers to Dr. Fowler's very valuable paper on "The Conservation of Nitrogen." Some time might also be devoted to the study of the values which are obtained from tankage by the large packing houses of this country. After absorbing this information the conclusion will certainly be reached that the values in sewage sludges are well worth conserving when handled in a sanitary manner and the sludges produced in a condition which can be practically handled by the consumer. The *second* is the desirability of using the Association's influence in securing the services of the Federal Department of Agriculture in thoroughly investigating the value and use of sewage sludges as a fertilizer.

Highway Preparedness in West Virginia

West Virginia has set an example in preparing for highway work in 1922 which should be followed by every state of the Union that has not already taken or prepared to take similar action. On November 17th it awarded contracts for road work to be done next year, thus giving the contractors abundant time to obtain and transport materials and make preparations for actual construction as soon as the weather conditions permit in the spring. In fact, it is probable that some of the work may be done during the winter, especially the grading.

Nine contracts were let located in as many counties of the state and totaling about 39 miles, the total amount of bids reaching about $750,000. Four include grading and draining only and the other five include, in addition, paving with bituminous penetration macadam in three cases and with concrete in the other two.

Refuse Collection in Peoria

By E. E. Pierson

The refuse of Peoria, Ill., is collected under two classifications, ashes and rubbish in one and garbage in the other. The ashes and rubbish are dumped in low places about the city, while the garbage is taken by a company known as the Peoria By-Products Co., which feeds it to pigs.

The cost of collection is said by Charles Kaufmann, superintendent of ash and garbage collection for the city, to have been greatly reduced by the use of the trailer system, which was adopted about a year ago. The total cost of operating in 1920 was $55,846 and the cost for 1921 will probably be about the same. For this sum collections of ashes, rubbish and garbage are made from an estimated number of 24,000 households, giving the annual cost as $2.32 each.

During the summer months the amount of garbage collected averages 12 loads per day, but only 6 loads per day during the winter months. Ashes and rubbish average about 85 loads a day. The city is divided into 16 districts or routes for ash and rubbish collection and into 4 routes for garbage collection. During the first four days of each week collection is made from alleys and during the last two days from those houses which do not hav access to alleys. It is required that garbage, ashes and rubbish be placed, in receptacles of a size that can be handled by the collectors, in alleys where there are any, and otherwise on the street curb Garbage is collected twice a week during the summer months and once a week during the fall, winter and spring.

Collection is made in small trailers which when filled, are brought to the headquarters of the garbage department. At this point the trailers are connected up into trains of 4 to 6 and are hauled by trucks to the dump or the yards of the By-Products Co. From May first to October first 4 men and about 12 trailers collect the garbage, and about half this number during the fall and winter. The trailers used in collecting the garbage are owned and furnished to the city by the By-Products Co., but are loaded and hauled to the company's yard by city employees and trucks. (A tractor and train of trailers in front of the department's office is shown on the front cover of this issue.)

Asphalt Paving in Pittsburgh

Pittsburgh, Pa., laid 484,280 square yards of asphalt pavement in 1921, all of this having been done by the city direct and not by contract. This is more than double the amount laid in 1920. This statement was made by Director of Public Works Norman F. Brown on November 15th, and it was his expectation to increase the total by 50,000 to 100,000 square yards if work remained favorable for a sufficient number of weeks longer. This work includes the repaving and repairing of streets in the residential section and the construction of park roads.

Duncannon Highway *

Preparation of roadbed, mixing, placing and curing of concrete. Special pains to secure proper consistency and protection of concrete, location and construction of expansion joints.

The old road surface was thoroughly loosened by a Western Grader Company's scarifier and after being brought to required grade was compacted by continual operations of two 10-ton Buffalo-Pitt rollers until a satisfactory flat surface was everywhere secured, and all soft spots and irregularities corrected and rerolled.

All culverts were constructed well in advance of the rolling. Great care was taken in setting the reinforced concrete culvert pipes, which were never placed in the fill, but were invariably set in carefully prepared beds with excavations for the hubs in the undisturbed surface of the solid ground. The pipe was placed with a grade of 1 to 30, the joints thoroughly filled with cement mortar and the ends protected with head walls and the pipes themselves well covered with thoroughly tamped earth before the backfill was placed and subgrade rolled above it.

PAVEMENT FORMS

The concrete pavement was laid between Blaw-Knox steel forms, of which 2,000 linear feet were provided and at least 200 feet were always laid in advance of the concrete mixer. They were kept thoroughly greased and carefully inspected for straightness and cleanness before using, were carefully set by long spirit levels and firmly staked in position. The alignment to tangent was made by setting the forms to a tightly stretched string on one side of the pavement and by careful measurements for the opposite side. On curves of more than 300 feet radius the steel forms were bent or sprung to accurate conformity with the tabulated ordinates to the chords given in the inspector's hand book of instructions.

STEAM ROLLER STRAIGHTENING ROLLS OF REINFORCEMENT FABRIC

CONCRETE MIXING

The 1:2:3 concrete was mixed in a 5-bag Koehring mixer, which, however, was only operated as a 4-bag machine, thus turning out 24 cubic feet of concrete in a batch. Each batch was mixed at least 1¼ minutes, and the average output of the machine was 300 linear feet per day with a best record of 455 linear feet, one batch of concrete sufficing for 1.4 linear feet of pavement 18 feet wide. The mixing machine was operated at not less than 14 nor more than 20 revolutions of the drum per minute and great care was taken to secure the proper mixing and consistency of the concrete, the bags of cement being occasionally checked by weighing, and strict watch was observed to prevent loss through leakage or careless handling of the bags. The empty bags were counted, piled and recorded at short intervals, and the cement was protected from wind and weather while it was handled and transported.

Care was taken to secure uniform and satisfactory consistency of the mixture that would afford from 65 to 85 per cent of the maximum strength of the concrete, which was made extra dry on account of the machine finishing. The amount of water was controlled by an automatic measuring device adjustable to different requirements occasioned by changes in the aggregate or by weather conditions. The mixer was also equipped with an automatic batch meter that locked the machine so that the concrete could not be discharged until after the aggregate had been mixed the required length of time.

FRESH CONCRETE PROTECTED BY CANVAS COVERS AND BY FLAT SHEETS OF BURLAP

PLACING AND FINISHING CONCRETE

Before placing the concrete, the surface of the foundation was carefully tested by the scratch template applied just behind the mixing machine so as to detect any elevations or depressions in the surface by scratches made by projecting sharp points or by their absence in hollow spots. The former being shaved and the latter filled and rolled if necessary.

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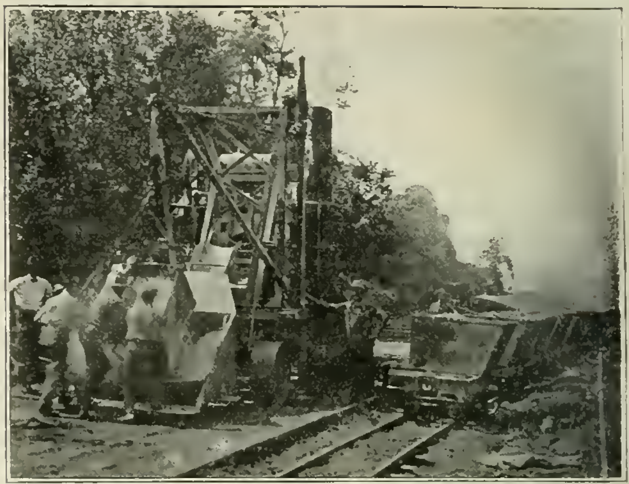
*Part I, General description. Grading Excavation, storage yard and delivering of aggregate was published last week.

The mixer, mounted on caterpillar traction, travelled on the subgrade without injury to it and discharged the concrete into a bucket travelling on a horizontal boom swung back and forth across the pavement and distributing the concrete in a narrow stream through a long opening in the bottom of the bucket transverse to the axis of the road, thus eliminating most of the hand placing of concrete, which was done entirely by shovels, the use of rakes not being permitted.

The mixer was followed closely by a Lakewood finishing machine, that went over the surface of the concrete four times, operating the belt finisher from 2 to 4 times according to conditions. Care was taken to operate the finishing machine with great uniformity, it was moved slowly with only a small amount of extra concrete permitted to accumulate in advance of the blade. Whenever the machine came to a stop it was moved back a short distance and then when it was again started tamping was not resumed until after it had advanced a foot or more. The joints were finished with a wooden float operated from a bridge spanning the pavement. The outer edges were rounded to a radius of ¾ inch and the joints to a radius of ⅛ inch. The forms were not removed until after the concrete had been in place 24 hours.

EXPANSION JOINTS

The expansion joints were located at both ends of convex vertical curves, at the upgrade sides of concave vertical curves, and on horizontal curves at the P. C.s and P. T.s and at some intermediate points, with a minimum distance of 100 feet between joints.



AGGREGATE IN BATCH BOXES HAULED ON INDUSTRIAL TRACK AND DELIVERED TO HOPPER BY DERRICK ON MIXER

The expansion joints were laid against perfectly smooth, straight and well greased steel bulkheads placed on the side next to the mixer secured by at least 10 temporary steel pins, 12 to 18 inches in length, and at least 5 additional permanent pins driven against the Elastite filler, with their tops 2 inches below the surface of the concrete. After at least 10 feet of concrete had been placed beyond the bulkhead, the latter was removed subsequent to gentle spading, and the surface of the adjacent pavement finished by a careful workman and tested with a 6-foot straitedge. At the end of each half day's work a transverse construction joint was formed against a 3-inch wooden bulkhead. Expansion joints were placed at a maximum distance of 300 feet apart and an average distance of 150 feet. The concrete mixer was operated by a gang of 15 men and laid 415 linear feet of pavement per 10-hour day for one week, when the average haul was about 4 miles.

PROTECTION OF CONCRETE

As soon as the concrete was finished it was protected by several canvas covered frames 14 feet long, extending across the whole width of the pavement. Each frame had transverse ribs consisting of a horizontal bottom chord to which there was attached a long upper wooden arch strip sprung to a curve having a rise of about 4 feet at the center. These frames were handled by four men each and as fast as they were moved forward close to the mixer, leaving the fresh concrete uncovered, the latter was immediately protected by transverse strips of burlap 9 feet wide with wooden cleats nailed across the ends to keep them straight and facilitate handling.

On the following day the burlap was moved forward and the concrete covered with 2 inches or more of dirt that for at least 8 days, excepting in cool weather, was kept saturated by sprinkling.

The reinforcement fabric was received in rolls 250 feet long and 6 feet wide, which were delivered from the contractor's yard to the subgrade a short distance in advance of the mixer. The fabric was unrolled and spread, convex side up, on the hard level surface of the finished subgrade and rolled flat and straight by the 10-ton road roller moving back and forth over the full length one or two times, after which the fabric was cut into 18-foot lengths by a man with a measuring pole and a pair of heavy shears. This method was found to be more economical, quicker and more satisfactory than the use of rolls for straightening the fabric.

The concrete was deposited in two immediately successive layers, the first leveled

DELIVERY AND SPREADING CONCRETE FOR FINISHING MACHINE off to an elevation 2 inches below the required surface and on it the reinforcement was placed with transverse overlaps 6 inches wide, after which the remainder of the concrete was immediately spread over it and finished by the gasoline driven machine.

TEST SAMPLES

,At distances of about 1,500 feet the inspector took about 6 shovels of concrete from different places in the pavement covered by one batch after it was spread on subgrade, and before it was finished, and with it filled three special parafined cylindrical 12- x 12-inch and 12- x 6-inch paper moulds. These moulds were filled with a trowel and the concrete thoroughly puddled with a 1-inch iron rod, after which they were rotated on their vertical axis on the baseboard to insure parallel flat top and bottom bearing surfaces, and were covered for 24 hours with a damp cloth, and 48 hours more with moist earth, after which they were boxed, labeled and sent to the testing laboratories where they were tested when seven days old.

The contractor, McArthur Bros., employed an average total force of 208 men at wages of $.30 for labor and $.45 to $.75 per hour for mechanics. All of the labor was native born and many of the men came from local farms in 30 or more of their own automobiles, which presented rather an unusual appearance parked along the right of way during working hours.

Additional Work on Catskill Aqueduct

Steel pipe lines to be constructed in fourteen inverted siphons, to cost over six million dollars

Bids were received on November 10th for over $6,000,000 worth of work in enlarging the capacity of the Catskill aqueduct of New York's water supply, and the three contracts covering this work have since been awarded to Rice & Ganey, Inc., Frederick Snare Corporation and Thomas Crimmins Contracting Co., all of New York city, the low bidders on the three contracts.

It will be remembered that in building the original Catskill aqueduct, which was described in "Municipal Journal" for Jan. 19, 1910 and Aug. 23, 1911, the aqueduct was constructed of a considerable number of sections, some in tunnel and some of steel pipes, the latter being used as siphons in crossing valleys. The tunnels were made of sufficient capacity to carry the entire discharge of the Catskill water sheds which it was intended to bring to the Ashokan dam, since it was calculated that this would be cheaper than to build a smaller tunnel at first and another some years later when it became necessary. But in the case of the siphons, which are largely in cut and cover, it was calculated to be more economical to provide three lines of steel pipe and build only one of these at first, the others to be added later when increased consumption might demand them. In addition to financial considerations, it was thought that the opportunity to study rates of flow and the general working of the first siphon might permit improvements in the design or construction of the others which would be well worth while.

The present contracts are for completing the siphons and thus the entire aqueduct by adding at each siphon two additional lines of siphon pipes. There are 14 siphons, or 28 pipes, included in the three contracts above referred to. These are to be laid parallel to the pipe lines previously constructed and will be built in practically the same way, with a cement lining and a concrete outside cover, the pipes resting in concrete saddles, all as described in the article in our issue of August 23, 1911.

The grades of the tunnel sections at the ends of each siphon line are so located as to provide fall in the siphon sufficient to keep the flow line in the tunnels at the desired height at each end of the siphon at the normal rate of flow. In order to effect this, the sizes of the additional siphon pipes now to be added have been carefully calculated and vary in the different siphons depending upon the available head. The thickness of steel in the pipes of course varies with the head.

The first contract includes three siphons in Ulster and Orange counties; the second contract includes seven siphons in Putnam and Westchester counties; and the third contract includes four siphons in Westchester county, each siphon containing two lines of pipe. The pipes in the first contract comprise 5,605 feet of 8-foot, 4-inch pipe and 6,550 feet of 8-foot 10-inch pipe. The second contract comprises 1210 feet of 7-foot 4-inch pipe, 1380 feet of 7-foot 10-inch pipe, 5985 feet of 8-foot 4-inch pipe, and 25,320 feet of 8-foot 6-inch pipe. The third contract comprises 19,950 feet of 11-foot 3-inch pipe. The thickness of plates used in the pipes varies from 7/16 inch to 9/16 inch, lap joints being used in some cases and longitudinal butt joints being used in others.

The above sizes of pipe are those of the steel shell, but the effective size of the siphon will be reduced by the mortar lining, which is two inches thick, thus reducing the effective diameter by 4 inches in each case.

The lining is to consist of Portland cement and sand mixed as may be ordered, but generally one part cement to from 1 to 2 parts of sand if the mortar is poured into forms; although other mixtures may be specified if the lining is to be applied by a cement gun or in other ways suggested by the contractor and approved by the engineer. In pouring the lining, suitable forms are to be placed inside the pipe and the mortar, mixed to a thick, creamy consistency, will be poured through holes not more than 2½-inches diameter that are left in the top of the pipe at intervals. The pouring is to be continued until the mortar rises to a height of at least 4 feet in a vent pipe connected to the siphon pipe at the highest part of the section being poured; these vent pipes to be kept filled with grout until the motor is set, when they will be removed and the holes made tight by screwing iron plugs into them. The holes are reinforced by plates riveted to the pipe. During the pouring of the grout the forms are to be tapped to loosen air bubbles and all leaks in the forms must be stopped. The pouring of grout must be continuous from start to finish with no interruption of pouring exceeding 15 minutes. Where there are portions of the pipe which it is impracticable to line by grouting, plastering may be employed, the mortar being put on in thin layers, the surface of each layer to be brushed to thoroughly remove the laitance and scratched deeply to give a bond with the succeeding layer. In crossing Tongore creek, the exterior of the pipe is to be covered with mortar having a minimum thickness of 1½ inches and reinforced with steel fabric weighing not less than 0.3 pound per square foot. During the pouring of the lining in freezing weather, bulkheads will be placed in the pipe to keep out the cold air and prevent the freezing of the lining.

The outside of the pipe is to be covered with concrete having a minimum thickness above the spring line of 6 inches, with the outer surface vertical below the spring line and the thickness under the invert varying with the condition of the soil.

In carrying on the construction, the top soil is to be removed from designated areas before beginning the general excavation for the pipe trench to provide surface drssing for the embankments. Foundation embankments are to be completed at least six weeks before masonry is laid on them and should therefore be the first part of the contract to be performed. The steel pipes after being laid are to be tested and made tight against hydrostatic pressure corresponding to the hydraulic gradient of the aqueduct, and the outside concrete is to be placed while they are still under this pressure.

The quantities run into quite high figures. For instance, in the second contract the estimated quantities include 25,00 cubic yards of removal of soil, 218,000 cubic yards of earth excavation and 21,600 cubic yards of rock excavation; 203,000 cubic yards of refilling and embanking and 22,000 cubic yards of surface dressing. 100,000 pounds of steel will be required for reinforcing the concrete, of which there will be 1000 cubic yards reinforced and 44,800 cubic yards not reinforced. There will be 880,000 square feet of mortar lining in the steel pipes.

The contractor is required by state law as well as by the contract to make proper sanitary provisions for the men in camps and on the work, but it is hoped that practically all of the men except those on the work nearest to the Ashokan dam and the watchmen and a few others, will live in neighboring towns and villages and thus eliminate the objectionable features of construction camps. However, the contracts require that the contractor furnish medical and surgical practitioners, estimated, for the second contract, at 150 practioner-months, 40 months of sanitary services, 25,000 pounds of chlorinated lime and 60,000 pounds of liquid chlorine to be used in 10 automatic chlorine dosing machines, while the other contracts call for amounts somewhat less than this. The times of services given above are estimated but "the contractor shall employ medical and surgical practitioners to the number required from time to time. For each such practitioner employed in accordance with orders the contractor shall receive payment at the rate per month stipulated." Under sanitary services the specifications include the care and maintenance of the sanitaries; the collection, disinfection and disposal of garbage, excreta and other waste; the maintenance and operation of sewers, sanitary drains and chlorination and other disposal works; the disinfection and fumigation of quarters, stables and grounds; care of the health of the employees; lighting of the camps and other surroundings, etc. Compensation for each of these is to be at the price per month stipulated, the time of payment being considered as beginning when a force of men begins the erection of the sanitary conveniences, and will be considered as ended 15 calendar days after the removal of the last of these conveniences has been authorized. The liquid chlorine machines are to be used for sterlizing drainage or stream flow in order to prevent morbific pollution of waters flowing in the several watersheds crossed by the aqueduct.

SOME SPECIFICATION ITEMS

The specifications contain several features out of the ordinary. The successful bidder is required to give bonds of $250,000 in the case of one contract and $500,000 for each of the others. "At the expiration of each year after the date of onctract, the liability of the sureties under the bonds will be reduced in the proportion which the amount of work done at that time, as shown by the partial estimates, bears to the estimated amount certified by the board to be expended under the contract, until such liability shall amount to 20 per cent of the original liability, at which amount the bonds shall remain in full force and virtue until the completion of the entire work."

"The attention of bidders is especially directed to the time for the completion of the various parts of the work. Such rates of progress will be required as will give assurance of the completion of all parts of the work within the prescribed time."

"The attention of intending bidders, particularly those who may fail to appreciate the essentials through lack of experience in water works construction, is directed to the exacting requirements of the specifications intended to assure safe, watertight and otherwise adequate structures. The bidder should realize fully that the first-class materials and workmanship specified must be supplied in full measure in order to produce acceptable structures of the kind specified."

Provision is made for work or materials that are "not susceptible of classification under the items of the contract" but which may be ordered by the engineer, for which the contractor shall be paid cost plus 10 percent, administration, general superintendence and profit to be included in the 10 per cent and not in the cost. However, such special work cannot in any case exceed 5 percent of the estimated amount of the contract.

The contractor is required to pay the workmen in cash and not in store orders or other script, nor will he be allowed to conduct a company store if there is a store selling supplies within two miles of the place where the contract is being executed.

The contractor is required to give a bond in the sum of $5,000 to each municipality in which his work may be located to indemnify such municipality against "any loss, expense or charge that said municipality may legally incur because of paupers or indigent employees brought into said municipality and having no settlement therein."

Partial estimates are to be made by the engineer as a basis of payments not oftener than once a month, but no estimate will be made unless the amount of work since the previous estimate totals at least $10,000. Ten percent is retained from the monthly estimates.

Considerable variation in the bids, both for the several items and the total bids, were submitted by the various bidders. For instance, for the first contract (known as contract No. 209), the low bidder, who received the contract, submitted as his total $999,325, while the total for the highest bidder was $1,998,826. In the various items the difference was still greater. For instance, for earth excavation the low bid was $.80 a cubic yard and high bid $4.50. In the lump sum for stream and highway crossings, the lowest bid was $6,000 and the highest bid $160,000. For furnishing and laying the steel pipe the bids varied from $25 to $75 per foot for the lighter weight and from $35 to $110 for the heavier weight. It would seem as though the concrete masonry, delivered in bulk between the pipe and outside forms, would not offer sufficient departure from ordinary construction or sufficient risk to lead to much difference in prices, but the bids varied from $6.42 a cubic yard to $27. For furnishing automatic chlorine dosing machines the bids ranged from $1000 each to $5000. The greatest difference of all was the lump sum item of cleaning up, for which one contractor bid $500 and another contractor $14,800.

While in a general way the low bidders were low on all items and the high bidders were high, this did not follow consistently through all the items. For instance, the highest bidder bid $1.00 a cubic foot for "cutting concrete," while the average of all the bids was $4.21; also his bid for steel castings was 12 cents while the average of all bids was 18 cents. The low bidder was only about 5 percent below the next lowest, and his bid was apparently well-balanced, as in the case of only a few minor items were any of his bids higher than the average of all the bidders.

Unemployment in New York State

During November the secretary of the New York State Bureau of Municipal Information, William P. Capes, wrote to the mayors of all the cities in the state of New York asking concerning the condition as to unemployment in their respective cities. Forty cities replied and the general tenor of these replies bore out the opinion which we have already expressed that, in this section of the country, the amount of unemployment is little more than is usual at this time of the year. A number of these cities described plans which they were making for relieving or preventing unemployment, but did not state what amount of unemployment there was at present in the city. Of those that replied, seven stated that conditions were normal; nine that conditions were not serious; six that there was no unemployment; 4 that there was little unemployment, and one that labor was quite scarce.

The mayor of the last named place, White Plains, wrote: "There is very little unemployment in White Plains, in fact it was necessary for me to give a representative of the 'Builders' Trade Council' a letter so that he might go to the various cities in the state and hire mechanics to come to White Plains."

Among those listed as not serious is Tonawanda, whose mayor wrote: "The city has built a filtration plant at a cost of $250,000, has paved streets at a cost of $222,000, has laid new water mains at a cost of $50,000, and has constructed new sewers at a cost of $40,000. This and other work that has been and is now being done by private individuals have relieved the situation in our city considerably. The situation has not been bad and is not now, as our charity disbursements are not any more at the present time than they were a year ago."

Albany's mayor reported that he attended a meeting of representatives of the Chamber of Commerce and all the charity organizations and that "The conclusion we arrived at was that the situation in the matter of unemployment was about normal and we deemed it advisable not to disturb our people by the appointment of any committee on unemployment at the present time."

Profits from Muncipal Dam

The city of Fort Dodge, Iowa, with about 30,000 population, completed the construction of a municipal dam in March, 1918. This dam, which is 412 feet long with a 230 foot spillway section, was described in our issue of May 11, 1918. It was built under the plans and supervision of Burns & McDonnell of Kansas City as engineers, which firm also conducted a bond campaign under the auspices of the Commercial Club, which was carried by a large majority in June 1916. The engineers had calculated that the dam with its hydro-electric plant would be a profitable investment for the city, in addition to which there was the very influential reason that the dam would create a lake that could be utilized for pleasure purposes. The dam has met all expectations from both standpoints.

The city utilizes part of the current created at the dam for the operation of its own water works plant and the surplus current is sold to the local light and power plant. The rates made to the power plant were very low because of its taking surplus current, and these rates were reflected in reduced rates to the citizens. The plant has been operated by John W. Pray as superintendent.

The turbine and generators of this plant are in duplicate and have a total capacity of approximately 2000 h.p. The entire cost of the project was $160,000, $100,000 of which was raised by 25-year 4½ per cent bonds and the remaining $60,000 was paid out of the earnings of the municipal water works. The gross revenue for the fiscal year from April 1920 to April 1921 was $45,431 and the gross expenses for the year were $12,294, leaving a net profit over expenses of $33,237. Allowing a depreciation on an assumed life of the dam of 60 years and on that of the machinery and the power equipment of 25 years gives an annual depreciation of $2,220. The sinking fund for paying off the bonds in 25 years amounts to $4320 a year and the interest is $7,230, giving a total of $13,740 or, including operating expenses, of $26,034. Deducting this from the gross revenue leaves a clear profit of $19,497 or 12.18 per cent on the total investment.

At this rate of return the city will have the project entirely free from debt before the expiration of the bonds, and at the latter end of the 25-year period, because of reduced interest and sinking funds, the project will be paying the city over 20 percent net on the investment. Although the income is high, the rates are low, the water works pumping plant being charged for current at the rate of 1 cent per kwh., while the surplus current is sold to the local light and power plant at 0.85 cents per kwh.

The city was able to borrow the funds for this development at 4½ percent, while a private company would probably have had to pay twice this rate, which item alone would have reduced the profit to less than 8 percent. This indicates one reason why a municipal plant should be able, if operated as efficiently and economically as a private one, to earn a larger profit.

In addition to the immediate profit from the plant, the city, by reason of being able to offer power at a low rate, possesses this advantage in efforts to secure new industries. The lake formed above the dam has created a pleasure resort which is enjoyed by large numbers of the citizens.

New Orleans Sewerage and Water Board Controversy

A controversy has been carried on for some weeks between the New Orleans Sewerage and Water Board and the Commission Council, which was finally taken to the courts and a decision was handed down December 6th by the civil district court for which an appeal has been asked for by the Commission Council.

The council made an appropriation of $188,000 for the use of the Sewerage and Water Board during the year 1922, but the board had insisted that this amount would be nowhere near adequate but that $424,000 would be necessary. The council had asked the board that it submit its books to the council's "Survey Commission" with a view to determining whether economies in the operation of the board might not be possible, but this the board had refused to do, and the council thereupon refused the demand of the board for $424,00, although the president and engineer of the board had stated that unless this sum were available the board would not be responsible for the continued operation of the drainage system throughout the year. The board obtained a temporary mandamus to compel the council to make the desired appropriation and Judge King of the civil district court returned a decision making this permanent. The commissioners have appealed from this decision to the Supreme Court. They state that if they are required to make this appropriation, the tax rate will have to be increased from 85 percent to 88 percent, or else the city must abandon its 1922 paving program.

Superintendent Earl of the board stated that he would not dare to ask for less than $424,000 if the city's drainage work is to go on. It was explained that much of the machinery of the drainage system is 20 years old and obsolete and that all the reserve funds that might be used for replacement have been exhausted and no others are available. Also the board is powerless to increase its water rates, its only source of income other than council appropriations. No reason appears to have been given publicly for the refusal of the board to permit an inspection of its books and records by the council's survey committee, which was apparently the point around which centered much of the hard feelings that appear to have engendered between the board and the council.

Engineering Lectures at Rutgers College

At Rutgers College a series of lectures is given under the auspices of the Student Branches of the A. S. C. E., the A. S. M. E. and the A. I. E. E. for the benefit of Freshmen, in order that they may have an outline of the many branches of the engineering profession and thereby have a better knowledge and purpose in the selection of their particular course and some understanding as to the qualifications of the engineer.

Civil Engineering was presented November 24 by C. D. Pollock, M. Am. Soc. C. E., of New York City, in a lecture entitled "Civil Engineering—Its Present and Future Prospects," and on December 1st George A. Orrok, consulting engineer for the N. Y. Edison Co. and power plant expert, lectured on "Central Station Development." On December 15th, C. R. Dooley, manager of personnel and training of the Standard Oil Co., will speak on the "Training and Qualification of the Electrical Engineer."

In the first of these Mr. Pollock, Prof. Harry N. Lendall informs us, "emphasized the fact that the successful engineer must be loyal to the profession and not consider the dollar paramount; that it is not necessary to specialize along any one particular line but, instead, to have a thorough grounding in methematics, physics and mechanics together with a broad training in economics, history and English.

"He then outlined the various branches of civil engineering, giving the scope and possibility of development in the future. Regarding the prospects for civil engineering students of today he said: 'Just now, due to business conditions, there is little demand for civil engineers. This is but a temperary condition in the development and progress of our country and the world at large. The electrification of railroads, the extension and improvement of highways, the development of water power and irrigation works, the thousands of rapidly growing towns and cities requiring new water and drainage systems, the new and increasing demand for engineer-executives, all of these will offer in the future many and growing opportunities for the young men who are now in our engineering schools.'"

Kansas City Votes Down Water Bonds

In November, 1920, Fuller & McClintock, consulting engineers of New York, presented to the board of fire and water commissioners of Kansas City, Mo., a very comprehensive report on improving the water supply of that city, embodying the result of an investigation made during the ten months previous. The general findings of this report have already been given in PUBLIC WORKS.

With a view to carrying out the recommendations of the engineers, the citizens were asked to vote at a special election November 22nd on a bond issue of $11,000,000. A two-third majority is required in favor of bond issues, and the vote is reported to have been slightly below this, although a fair majority of the votes were in favor of the issue.

PUBLIC WORKS

Published Weekly
at 243 W. 39th St., New York, N. Y.

S. W. HUME, President J. T. MORRIS, Treasurer

Subscription Rates
United States and Possessions, Mexico and Cuba $3.00 year
All other countries .... $4.00 year

Change of Address
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Telephone (New York): Byrant 9591
Western office: Monadnock Block, Chicago
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Percentages Deceptive

"A screen of two-inch mesh may give as high a percentage of removal of suspended matter as one of 30 meshes to the inch under certain conditions, such as the screening of clear water with only a tennis ball as the suspended matter, the percentage then being 100." This statement, made at the recent convention of the American Public Health Association, impressed the writer as an excellent illustration of the possible deceptiveness of percentage when used without full explanation of all the qualifying conditions.

But the deceptiveness is not confined to such extreme or unusual conditions. There are several uses made of percentages in water purification and sewage treatment work that are deceptive to the casual reader because of the method of using them. For instance, the records of the tests made on Chicago stockyards sewage show 353 parts per million of total suspended solids in the effluent as the average for July and 354 parts for the following April; but the efficiency of the screen in percentage reduction of suspended matter averaged 7.4 percent in the former month and 24.7 in the latter. Judged by percentage of reduction, the screen appeared to be more than three times as effective in April as in July; but in fact the result aimed at in screening, producing a clarified effluent, was exactly the same both months. By dumping some sawdust or other coarse matter into sewage it is possible to make a screen show very high *percentages* of clarification, or by adding quantities of colloidal matter to show very low ones. (In testing the clarifying efficiencies of settling tanks, *settling* solids are now used as the basis of comparison. Why not use the *screenable* solids in the effluent for comparing the efficiences of screens?)

Take again the matter of bacteria reduction. If a filter effects 99.5 percent reduction on a polluted water containing 60,000 bacteria per cc., there still remain in the effluent 300 bacteria per c.c. But a filter attaining only 85 percent efficiency when treating a water containing 600 bacteria per c.c. gives an effluent with only 90 bacteria per c.c. or only 30 percent as many as the first filter.

An even more deceptive use of percentages is that of describing sludge as having a certain percentage of moisture. (See the first article in this issue.) If a sludge containing 96 percent moisture be reduced to 48 percent moisture, it might be thought that one-half the water was removed and the volume of sludge reduced about one-half. As a matter of fact, in the first sludge there are twenty-four parts of water to one part of solid, while in the second there is slightly less than one part of water to one of solids, and as the solids are the same in each case (less a small percentage carried away with the excluded water) 96 percent of the original water has been removed and the sludge occupies about one-thirteenth of the original volume. This would be more apparent if the consistency be expressed in percentage of dry solids instead of water, as is done by English engineers, when the above sludges would be described as 4 percent dry solids and 52 percent dry solids respectively.

To specialists in the subject these ideas have become familiar and are not deceptive; but others are not apt to appreciate the real significance of such percentages, and it would seem advisable to change the practice so that the percentage would give directly rather than indirectly the true significance of the results.

The Science of Bidding

Considering the millions of dollars' worth of work that contractors bid upon and construct every year and the vital importance to them of bidding low enough to get the work but high enough to make a profit on it, it would seem as though successful contractors must have developed as great skill in estimating the cost of proposed work and bidding upon it as they have in executing it. (There is also probably an *art* as well as a *science* of bidding, or performing other acts connected more or less directly with bidding and having their effect upon the acceptance or rejection of the bid.)

When we come to examine bids, however, it is difficult to persuade ourselves that there is really such a thing as a science of bidding. Of course scientists differ somewhat among themselves in their interpretation of data and in developing theories based upon them, but we do not find two scientists disagreeing widely in their opinions on matters such as the strength of steel or of concrete, or even that evasive unit, the bearing power of a given kind of soil, as compared with the differences found in bids upon the same work by different contractors.

An illustration is furnished by bids on contracts for the extension of the Catskill aqueduct, described elsewhere in this issue. The specifications for this work were unusually complete and explicit and the money involved, totaling from $1,000,000 to $3,000,000 on each contract, would seem to make it worth the contractors' while to analyze the conditions carefully and figure as closely as possible. Moreover, as the bidders were required to deposit with each bid a certified check for $25,000 and bonds for half a million dollars were required, it is to be assumed that they were contractors of experience and amply able to employ competent experts to figure for them.

In spite of this we find bids on one item varying from a lump sum of $6,000 by one bidder to $160,000 by another bidder, or nearly 30 times as great. This was for crossing of streams and highways, concerning which there might have been room for uncertainty. There would seem to be little uncertainty, however, in the furnishing and laying of steel pipe concerning which it is possible to calculate to a fraction of a percent the number of pounds to be handled, the number of rivets to be driven, etc. And yet for this item the bids varied from $25 per foot to $75 for one weight of pipe and from $35 to $110 for another weight; that is, one contractor was bidding about three times as much as another on an item which it would seem possible to estimate on very closely. There was also included in the contract more than 14,000 cubic yards of concrete masonry to be placed around the pipe and therefore under much the same conditions as would be involved in building a concrete sewer; that is, with the simplest of forms, into which the concrete could be poured continuously from the mixer. In spite of this condition, the bids varied from $6.42 to $27, or nearly 400 percent. Nor was the high bidder consistent in the altitute of his bids, since in several cases his bids was lower than the average; for instance, for 10,000 pounds of liquid chlorine he bid 10 cents per pound while the average of the fifteen bids was 15.2 cents.

These figures show contrasts that are remarkable if compared on the assumption that bidding is a science, but are not remarkable when considered in the light of bidding as it generally takes place. Differences of 50 percent to 100 percent in the amounts bid are by no means uncommon on all classes of work.

There are three assumptions that can be made to account for this condition. One is that many of the bidders cannot estimate within 50 percent of what it will cost them to do a given piece of work; another, hat some contractors can do a given piece of work 50 percent cheaper than others. Probably each of these conditions play a part in the existing condition of wide variations between bids. The third assumption is that some contractors desire to make a big profit or none at all, and continually "take fliers" at lettings in a hope that some time they may win a contract at such a fat price that it will pay them for losing the others.

It is undoubtedly true (although not so much so now as formerly) that in many cases the lowest bidder could not possibly execute the work at the prices bid. In fact, we have heard it stated that where there is a large number of bidders the lowest quarter of the bids are generally below the lowest possible cost of construction, and the highest quarter are beyond reason, while the middle half represent intelligent and reasonable bidding by contractors who appreciate the difficulties of the work but are not attempting to make exorbitant profits.

Whatever the explanation, it would seem to be certain that there is much yet to be learned in contracting as a science if one contractor can execute almost any piece of work at half what it would cost another; and in the science of bidding, if experienced contractors differ among themselves by fifty percent in estimating the cost of doing a piece of work with no unusual hazards or construction features.

New York Highway Work in 1921

The state of New York has completed this year a larger amount of highway work than in any previous year of its history. Since February 1st, when Herbert S. Sisson took charge of the department, more than 615 miles of highway has been paved, on which it is estimated that the contractors have paid out more than $7,000,000 in wages. The contracts let this year amounted to $25,535,085. The unusually favorable weather conditions and the considerable decrease in cost of materials and labor have aided in making this a record year.

Of the construction this year, 366 miles were built of reinforced concrete, which was used for the heaviest traveled highways.

Considerable damage has been done to the roads in the past by trucks whose weight exceeded the limit set by law and the road inspectors this year have been instructed to enforce the law strictly and many arrests have been made for injuring the improved highways.

Milwaukee Sewage Plant Contracts

The Milwaukee sewerage commission has finally approved the plans for an activated sludge plant on Jones Island which is estimated to cost $2,000,000 and it is announced that bids for constructing it will be opened during the early part of 1922. It is expected that the construction of the plant will consume about two years.

Delaware's 1922 Highway Program

The state highway department of Delaware announces that its construction program of 1922 will total about $2,250,000 and that the first letting for construction will take place the last of February, giving several weeks in which successful bidders can prepare for beginning operations with the first favorable weather of the year.

Recent Legal Decisions

STREET RAILWAY'S DUTY AS TO PAVING BETWEEN AND OUTSIDE RAILS

In a proceeding on the complaint of a municipality alleging failure of street railway companies to comply with a municipal ordinance with respect to paving, the Pennsylvania Public Service Commissioner holds, Swarthmore v. Philadelphia, M. & S. St. Ry. Co., that an ordinance requiring the railways to pave the entire width of the streets and imposing other burdens which would require a prohibitive rate of fare, is unreasonable. Where a roadway had been allowed by the municipality and the street railway company occupying it to get into such a state of disrepair as to endanger public safety, it is held to be the duty of the railway company to place that part of the highway occupied by its tracks between the rails and on each side of the end of the ties, in a safe and adequate condition for vehicular and pedestrian travel as well as for the operation of its own cars. This should be done by laying pavement of the same kind as the municipality adopts for the remainder of the highway.

CITY MAY EXTEND TIME FOR COMPLETION OF PAVING CONTRACT AND SO PROTECT LIEN FOR ASSESSMENT

Suit was brought to set aside certain paving assessments and to cancel the lien thereof on the theory that the paving contract was not performed within the time specified therein and that the city had no authority to extend the time. The contract required complete performance by a certain date "unless otherwise provided in writing, signed by the mayor and approved by the city council," and that failing such completion the contractor should pay to the city any expenses incurred by it on account of its requiring additional time. The contract, therefore, made time of the essence of the contract, not for the purpose of forfeiture, but for the purpose of imposing certain penalties of additional expense upon the construction company in the event of its failure. The construction company was not released from the obligation of the contract by its mere failure to perform it within the time specified. The city elected to enforce the contract and to grant additional time for that purpose, as it was in their power to do. The Iowa Supreme Court therefore holds, O'Shonessy v. City of Sioux City, 184 N. W. 728, that the lien could not be cancelled for the contractor's failure to complete within the contract time.

ADJUSTMENT OF CHARGES AND RATES FOR MUNICIPAL ELECTRIC PLANT

In granting an increase of electric rates for the municipal plant of the Village of Argyle, the Wisconsin Railroad Commission holds that (1) separate schedules should be established for light and power service rendered by a municipal plant; (2) street lighting service should return to such a plant its share of the cost of the service; (3) a municipal electric plant should make a charge of energy used to operate the municipal stone crusher; (4) energy used for electric pumping in the municipal water plant should be metered, although the municipality owns the electric plant.

ORDINANCE PRESCRIBING THAT HOSPITAL BUILDINGS BE CONSTRUCTED OF NONINFLAMMABLE MATERIALS HELD AUTHORIZED AND REASONABLE

The Georgia Supreme Court holds, Brigham v. Mayor & Council of City of Dublin, 108 S. E. 532, that under a city charter giving power to pass ordinances, etc., necessary or proper or incident to good government and to the peace, security, health, etc., of the inhabitants, and all other powers necessary or incident to municipal government not in conflict with any other special power or authority given the city, the mayor and aldermen were authorized to pass an ordinance prescribing that buildings to be used for hospital purposes be constructed of brick or other noninflammable material. Such an ordinance was held not to be void on the ground that it was unreasonable.

RIGHTS OF ASSIGNEE OF CONTRACTOR NOT PRIOR TO THOSE OF MATERIALMEN AND SUBCONTRACTORS

A contract with a city (for the construction of a sewer outlet and specification plant) provided for the withholding of the contractor's account until he furnished evidence that material bills "filed with the mayor and city council" were paid, and that he should be paid the final estimate after deducting all unpaid bills. The Iowa Supreme Court holds, Reynolds v. City of Onawa, 184 N. W. 729, that an assignee of such contract as security for advances was not entitled to preference, in payment of the balance of the contract price by the city, over claims for labor and materials, on the ground that these claims were filed with the city clerk more than the 30 days specified by Iowa Code, § 3102, after the furnishing of the last item. The rights of the parties were held to be governed by the contract, not by the statute, and filing accounts with the clerk was a substantial compliance with the contract condition that they should be filed with the mayor and councils.

The rights of the assignee, a bank, were not rendered superior to those of the materialmen and subcontractors by the fact that the principal contract had been assigned very soon after it was executed and before the claims of subcontractors accrued. What the bank acquired under the assignment was the right to stand in the contractor's shoes, and demand and receive from the city just what the contractor himself could rightfully demand and receive, had he made no assignment. It was immaterial that the assignment was known to the city and to subcontractors when they furnished the materials.

DISCRIMINATION IN MUNICIPAL WATER RATES

In allowing an increased rate schedule for water to the City of Linton, as lessee of the Linton Water Company's plant, the Indiana Public Service Commission holds that a "step" schedule of water rates is discriminatory and often encourages waste of water to secure a lower rate. Such a schedule should therefore be changed to a "block" rate. It also holds that there is discrimination in water rates when flat rate consumers are billed at $7.50 per annum, including surcharge, and metered consumers at a minimum charge of $15 per annum.

NEWS OF THE SOCIETIES

Dec. 20—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce. Secretary, Prof. W. H. Kavanaugh Un. of Penn.

Dec. 22-23—KANSAS ENGINEERING SOCIETY. Annual meeting. Hutchinson, Kan. Secretary, J. M. Averill, Topeka.

Dec. 27-30—AMERICAN ECONOMIC ASSOCIATION. Pittsburgh, Pa.

Dec. 28-29 — AMERICAN ASSOCIA-FOR LABOR LEGISLATION. Fifteenth Annual Meeting Pittsburg. Frederick MacKenzie, Director of Publicity, 131 E 23rd St., New York.

Dec., 27-31 — AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, SMITHSONIAN INSTITUTE, Washington, D. C. Toronto, Canada.

Jan. 4-14 — CLEVELAND, OHIO, BUILDING EXPOSITION. Municipal auditorium, Cleveland, Ohio.

Jan. 5-6 — AMERICAN ENGINEERING COUNCIL, FEDERATED AMERICAN ENGINEERING SOCIETIES. Annual meeting, Washington, D. C.

Jan. 9 — MEMPHIS ENGINEERS' CLUB. Memphis, Tenn. Secretary, A. S. Fry, Memphis.

Jan. 12 — ENGINEERS' CLUB OF DES MOINES. Des Moines, Ia.

Jan. 12-14—HIGHWAY ENGINEERS' ASSOCIATION. Baltimore Hotel, Kansas City, Mo. Secretary, C. W. Brown, State Hgwy. Dept., Jefferson City, Mo.

Jan. 13 — ENGINEERS' CLUB OF SEATTLE. Seattle, Wash. Secretary, Lyman T. Banks, 916 L. C. Smith Bldg., Seattle.

Jan. 14—LOUISIANA ENGINEERING SOCIETY. New Orleans, La.

Jan. 17-19 — IOWA ENGINEERING SOCIETY. 34th annual meeting. Sioux City. Secretary—Lloyd A. Canfield, Des Moines, Ia.

Jan. 17-19—ASSOCIATED GENERAL CONTRACTORS. 3rd annual meeting. Hotel Winton, Cleveland Ohio.

Jan. 17-20—ASSOCIATION OF CANADIAN BUILDING AND CONSTRUCTION INDUSTRIES. 4th annual conference. Royal Connaught Hotel, Hamilton.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Jan. 18-19—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. New York City.

Jan. 20—BRIDGE BUILDERS' AND STRUCTURAL SOCIETY. New York City.

Jan. 27 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Bldg., New York City. Secretary—G. I. Rhodes, 115 Broadway, New York City.

Jan. 27-28 — WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION. Kansas City, Mo.

Jan. 30—SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention Cleveland. Secretary Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING. 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' building, New York City.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention Curtis Hotel, Minneapolis.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

BROOKLYN ENGINEERS' CLUB

At the regular meeting, December 1, O. B. Whitaker, Superintendent of the Service Department of The Sperry Gyroscope Company, presented a paper illustrated by lantern slides, on: The influence of gyroscopic action in our daily existence; The application of the gyroscope to a compass; The Gyro Ship Stabilizer and results being obtained from it; Other applications of the gyroscope.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The program for the adjourned November meeting of the Society, was divided into three sessions for the discussion of important topics at the afternoon meeting.

November 16.—There was a Symposium "Stream Pollution and Sewage Disposal." Speakers—George T. Hammond, Kenneth Allen, John F. Skinner, W. L. Stevenson, Earle B. Phelps, Paul Hansen, W. K. Dittoe, Langdon Pearse, and T. Chalkley Hatton.

November 16, 921, 8 p.m.—The Monthly Business Meeting was followed by a paper "Odors and their Travel Habits," by L. L. Tribus, published in August "Proceedings." Discussion led by George C. Whipple, Stephen De M. Gage, I. S. Osborn, Rudolph Hering, Olin H. Landreth, Andrew J. Prevost, and Robert S. Weston.

November 17—Symposium, "Water Supply and Water Purification." Speakers—George C. Whipple, Allen Hazen, C. A. Emerson, C. E. A. Winslow, C. A. Holmquist, Robert S. Weston and Samuel A. Greeley.

AMERICAN SOC. OF MECHANICAL ENGINEERS

The 42nd annual meeting of the A.S. M. E. was held in New York City, December 5th-9th, and was devoted to the contribution of definite technical information of value in the elimination of industrial waste. The duties of engineers in relation to waste elimination, not only as professional men but as citizens was stressed by President Carman in his retiring address.

The professional divisions assisted greatly in the discussion. The Power Division presented papers on the heat balance of four large power stations, which brought out information of decided value in the determination of the most economical power-plant designs. Power-station operating efficiency, it was stated, cannot exceed that for which it was originally designed. The Fuel Division contributed four interesting papers pointing out the fundamentals involved in a program of fuel conservation. The Material Handling Division presented one paper which opened up the entire field of waste elimination by a more thorough utilization of materials-handling equipment. At the Gas Power Session Elmer A. Sperry presented the results of twenty years' work leading to the successful development of a compound Diesel engine.

The subject of education and training was given prominence at a session held on Mondayevening, December 5th, at which two papers were presented. Dean R. L. Sackett of Pennsylvania State College gave the results of an extended investigation into the methods of training developed in foreign countries and in the U. S. and Mr. D. C. Buell told of the work being done by the Railway Education Bureau of Omaha, Nebr., in the training of railroad men. It is the desire of the Committee on Education and Training in the Industries to bring out the fundamentals involved and to build the foundation for a constructive program of future industrial training.

On Thursday afternoon the Society for the Promotion of Engineering Education joined with the A.S.M.E. in a session to develop the subject of professional engineering for the industries. The needs of the industries were treated by F. C. Pratt of the General Electric Co. and president of the Yale Engineering Association and J. E. Otterson, president of the Winchester Repeating Arms Co.; and the problems of the engineering faculties by Dexter S. Kimball, Cornell University, and A. G. Christie, professor of mechanical engineering at Johns Hopkins University.

Important session meetings were the following: the Power Waste Session on the morning of December 6th, at which was discussed the heat balance of "Connors Creek Station of the Detroit Edison Co.," by C. H. Berry and F. E. Moreton; the "Colfax Station of the Duquesne Light Co.," by C. W. E. Clarke, of the "Delaware Station of the Philadelphia Elec. Co.," by E. L. Hopping, and of the "Hell Gate Station of the United Electric Light & Power Co.," by J. H. Lawrence and W. M. Keenan; the simultaneous sessions of the Management Waste Session and the Gas Power Session that afternoon, at the former of which W. N. Polakov spoke on "Making Work Facinating," and F. B. and L. M. Gilbreth discussed "The Process Chart," and at the latter of which Louis Illmer treated "Porting and Charging the Two-Stroke Oil Engines," and E. A. Sperry "Compounding the Combustion Engine"; the meeting of the Materials Handling Waste Session, the subject of which was "Industrial Waste in Handling of Material," by H. V. Coes, on the morning of December 8th; and on the afternoon of that day the joint session with the Society for the Promotion of Engineering Education, the subject of which was "Professional Engineering Education for the Industries."

(Continued on page 476)

New Appliances

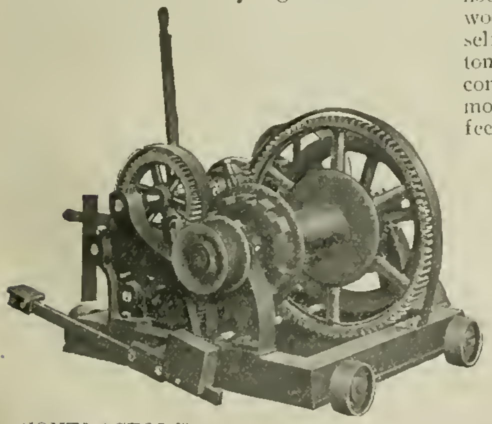
Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

HOISTING ENGINES AND DERRICKS

Single and double drum steam and electric hoists, manufactured by the Street Bros. Machine Works, are illustrated in Catalog No. 24. Illustrations show hoists for derrick work and general construction as well as for special purposes; also marine equipment, including windlasses, cargo hoists, steering gears, and capstans. The catalog lists cableway engines, dredging engines, excavating machinery, drill frame hoists and derricks.

One of the steam driven hoists illustrated has two drums, mounted at right angles to each other, and a spur driven swinging gear for full circle derrick. A complete set of fittings for the mast and boom, includes turnbuckles for the guys, that are provided to accompany this engine.

A small single drum hoist, made in two sizes weighing 1800 pounds and 1975 pounds, has its frame mounted on four small wheels, making it portable and convenient for general construction purposes on buildings up to 5 or 6 stories high for which sufficient length of cable can be wound on the drum. This machine can be operated either by an electric motor or by a gasoline hoist.



CONTRACTORS' AND BUILDERS' HOIST

The contractors and builders single drum hoist for building operations up to six stories may be driven either by an electric motor or a gasoline engine. The double cylinder drum engine with swinging gear for full circle crane is operated by steam or compressed air and is provided with a mitre gear, as shown in the illustration, which drives a vertical shaft, having at the lower end a pinion engaging a large circular rack for revolving the crane. With this engine there can be furnished standard gttings for the mast and boom, anchorage and bracing of the frame, and its rigging.

Single and double drum hoists are adapted to pile driving bridge erection and general contracting purposes, and are made of 15 to 60 h.p. There are also a double drum contractor's hoist without boiler, double drum derrick engine and an electric derrick hoist, four sizes, single and double drum electric hoists and belt driven hoists.

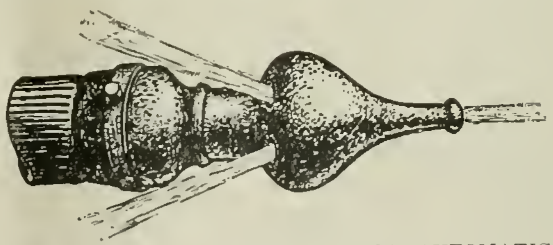
The catalog illustrates guy plates, goose necks, stiff leg irons, mast tops, brackets, bases and steps, boom ends, hook blocks and bull wheels for fitting wooden derricks and also illustrates a self-propelling derrick car of 5 to 20 tons capacity, guy and stiff leg derricks complete, and a traveling derrick mounted on a platform elevated several feet above the track.

VICTORY SELF PROPELLING NOZZLE

The Victory Self Propelling Nozzle, with one man, water at 25 pounds pressure or more per square inch and hose, will remove sewer, pipe, drain or culvert blockades in less time, with less trouble and for less money than in any other way. It avoids digging up streets, prevents the expense of replacing destroyed pavements and automatically locates and breaks up sewer stoppages.

Instead of using sewer rods, which are apt to pack the blocade even tighter than before, the Victory Self Propelling Nozzle travels under its own power, without any pushing or shoving, right up to the obstruction, and the water breaks up the blockade in record time.

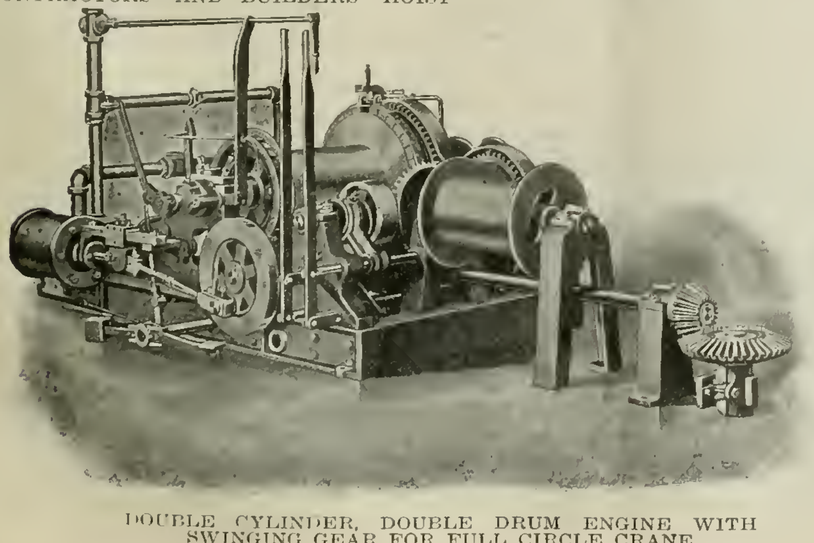
The Victory Nozzle is made by The Self Propelling Nozzle Co., Inc., from high grade bronze castings, with a small forward hole, and six large rearward holes in the dome. Diagonal flanges are cast in the neck, wihch is connected with a threaded butt by a ball-bearing swivel. The diagonal flanges and ball-bearings give the nozzle its revolting motion with a minimum of friction. The force of the water entering the dome pushes the nozzle forward, sky-rocket fashion, about 25 feet a minute, pulling the hose after it until it reaches the stoppage.



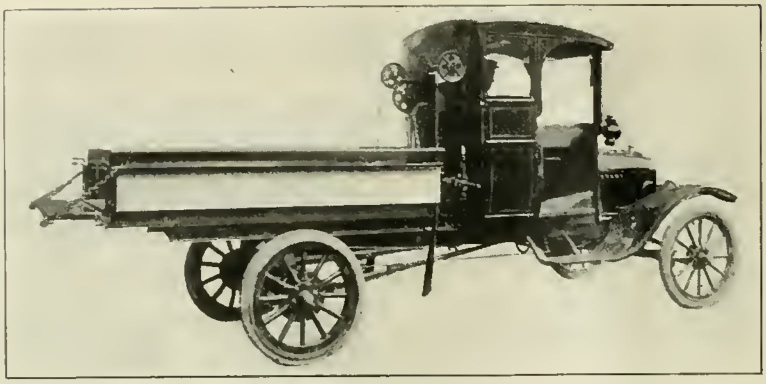
SELF PROPELLING NOZZLE FOR AUTOMATIC SERVICE

The forward stream of water breaks up the stoppage and the rearward stream washes it away. While this is going on, the nozzle is rapidly revolving, throwing the forcible rearward stream of water against the walls of the drain, so that as well as breaking up the blockade, they are giving the sewer a thorough cleansing.

Sewers more than two hundred feet long have been cleaned out and sand, stones, silt and sticks have been removed from them by using just water, hose and a Victory Nozzle. The Victory Nozzle is simple and compact. No working parts to get out of order. It is fool proof. Fires in soft coal piles, in cellars, under fallen walls, beneath roofs and in other inaccessible places are extinguished by the Victory Nozzle.



DOUBLE CYLINDER, DOUBLE DRUM ENGINE WITH SWINGING GEAR FOR FULL CIRCLE CRANE



STEEL BODY HAND DUMPED IN 30 SECONDS, LOWERED BY GRAVITY IN 5 SECONDS

ARCHER END DUMP HOIST AND BODY

The end dump hoist and body for Ford trucks that is manufactured by Archer Iron Works is hand operated and designed so that the dumping operation requires but 30 seconds, while the body itself is lowered by gravity in five seconds or can be held in any inclined position by means of a pawl and ratchet.

The steel body, 7 feet long, 44 inches wide and 14 inches deep is provided with double acting tail gate, with removeable wooden flare boards and can also be furnished, if desired, with special slide gate arrangement.

The Archer hoists and bodies are built in sizes of 1 ton up to 5 tons, and to fit all makes of trucks. They are recommended for road paving and for general construction purposes. The price of the hoist and body, complete, and ready for attachment to the truck is $140.00 cash to the trade F.o.b. Chicago.

INDUSTRIAL NOTES

Maher Engineering Company, Contracting Engineers, with offices in Chicago, Detroit, and Cleveland, announce the following changes in their organization:

Mr. C. B. Adams has been appointed Vice President and Sales Manager.

The Golden-Anderson Valve Specialty Co., Pittsburgh, Pa., has appointed Lawrence G. Whitsit and F. W. DuBois as its Michigan representatives They will operate under the name of the Waterworks Equipment Co, with offices at 8242 Woodward avenue, Detroit, Mich.

The Conti-Augustine Co., recently organized at Tom River, N. J., to manufacture cement blocks, has opened a plant in Berkely, N. J. and installed new machinery and molds

VEHICULAR TUNNEL REPORT

The 1921 report of the New York State Bridge & Tunnel Commission to the Governor and Legislature of the State of New York is a valuable and interesting volume with more than 200 9 x 12 inch pages of text and illustrations, fully describing conditions of the vehicular tunnel from New York to New Jersey, outlining the proposed procedure in the execution of the work by means of nine principal contracts for the New York Land Shaft, Uew Jersey Land Shaft, New York River Tunnel & Shaft, New Jersey River & Land Tunnel and River Shaft, New York Approach, New Jersey Approach, Ventilation Equipment Building, New York; Ventilation Equipment Building, New Jersey, and Installation of Tunnel and Ventilating Equipment with a tentative programme for completion December 31, 1924.

Different types of design and methods of construction are discussed and compared, presenting the reasons for the preference given to cast iron lined tunnels driven by the shield method. Drawings are given of details of the proposed cast iron tubes 29 feet in diameter and traffic and ventilation conditions are summarized.

The appendixes give the recommendation of the advisory transportation engineering committee; extended mathematical analysis of the cast iron lining stresses and design; investigation of tunnel gases and the amount and composition of automobile exhaust gases including full descriptions of the method of sampling and analyzing exhaust gases and details of the apparatus employed and practical discussion of the results and conclusions; and a report of tunnel gas investigation problem number 2, of the physiological effects of the exhaust gases.

The book is illustrated by many tables, full page illustrations and engravings and is of special value in presenting the latest investigation on tunnel questions that have recently arisen and for which little data is generally available.

(Continued from page 474)

NEW ENGLAND WATER WORKS ASSOCIATION

The December meeting of the New England Water Works Association will be held on the 14th at the Hotel Brunswick, Boston. At 10 a.m is scheduled the meeting of the executive committee at the headquarters, Tremont Temple; and at 2 p.m. the following papers will be delivered: "Electrical Operation and Control of Gate Valves for Water Works Systems," by Peter Payne Dean, New York city, and "Two Years in China," by Thomas H. Wiggin, Scarsdale, N. Y.

WESTERN SOCIETY OF ENGINEERS

The program of this society for December includes the following: Dec. 5. "Economic Features of the St. Lawrence-Great Lakes Water Ways Projejct," by Francis Shenehon, Minneapolis; Dec. 15, "Economic Consideration of ,Line Revisions on the Delaware Lackawanna & Western R. R.," by George J. Ray, Hoboken, N. J.; Dec. 19, "Operation of Sewage Disposal Plants," by H. H. Wagenhals, associate sanitary engineer, U S. Public Health Service, Cincinnati.

NEW JERSEY ASSOCIATION OF COUNTY ENGINEERS

Members of the Association and guests left Trenton 9.00 a.m., November 18th, via. Automobiles and inspected Brunswick Pike in Mercer and Middlesex Counties, and proceeded to Clarksville, to Lawrence Station, to Mercerville, Hamilton Square, Route No. 1, to Hightstown, to Manalapan, passing over State Maintenance work; turn left, Manalapan to Englishtown, passing Molly Pitcher's well, and Monmouth Battlefield, thence to Freehold, and inspected interesting Monmouth County work thereabouts.

After Luncheon at Lakewood, the party visited hangar built by Navy Department near Lakehurst for ZR-2 and proceeded over gravel roads through Monmouth, Burlington and Atlantic Counties, along Jersey Coast, dining at Sea View Golf Club, between Oceanville and Abescon. Inspected nearby New Highway Lighting Scheme of General Electric Co. and held meeting at 9.00 p.m. at Hotel Dennis, Atlantic City. Saturday visited Atlantic County bituminous work during morning. Lunched at Bridgeton Country Club and in the Afternoon, inspected work on State and county roads.

The following subjects were announced for discussion at the meeting:

Advisability of Counties building part of State Highway System under Reimbursement Act, as proposed by Highway Commission.

Exchange of ideas with Delaware and Pennsylvania Engineers.

Reports of Standing Committees.

Proposition of admission of Assistant County Engineers as Associate Members of New Jersey Association of County Engineers.

Establishment of a Clearing House for use of members of the Association, to be conducted by Secretary.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 51 DECEMBER 24, 1921 No. 26

Waterworks Tunnel Shafts

Seventeen feet in diameter through clay and solid rock to depth of 165 feet. Sides protected with vertical lagging and lined with concrete. Details of hoisting cage and guides. Pump equipment. Muck trestles and dump.

Western Avenue tunnel extension now under construction by the Waterworks Department of the city of Chicago will extend from the State St. shaft of section 2 of the Southwest land tunnel about 16,000 feet west on W. 73rd St., to the Western Ave. gate shaft, and thence about 17,000 feet north on Western Ave. to 45th St. It is being driven through solid rock from two headings in each of two shafts, one of them located at Wood St., about 4,000 feet east of the Western Ave. gate shaft and the other at 51st, 3,000 feet north of the same shaft.

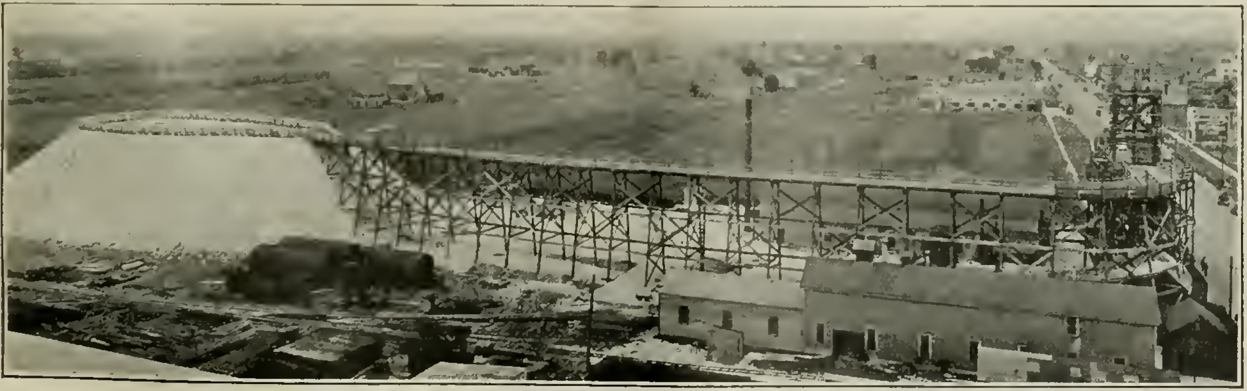
The Wood St. shaft penetrates through yellow and blue clay, boulders and sand for about 40 feet to the surface of the hard limestone rock, through which it is driven about 118 feet farther to the bottom of the tunnel inverts. The 51st street shaft penetrates about 48 feet through stiff blue and yellow clay and 8 feet through hardpan and about 19 feet through limestone to the invert of the tunnel.

SHAFT SINKING

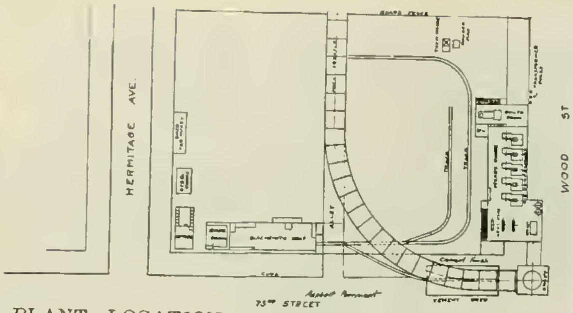
The shaft excavation, 17 feet in diameter, was made through clay by the Chicago wells process with pick and shovel work. No difficulty was found in keeping the shafts dry, because little or no water entered them except from a broken sewer adjacent to one of the shafts.

As fast as the excavation permitted, the sides were retained by successive sets of 2x6-inch maple lagging 6 feet long, planed on all sides, with their edges radial to the axis of the cylindrical surface and bearing at each end on an interior 4x1-inch sectional horizontal ring with flange bolted connections. At the center of each section of the lagging there was placed a 9-segment full-circle arch of 10-10-inch timbers thoroughly wedged and locked to bearing on the lagging at the joints and at intermediate points.

Excavation was made by a 6-man gang that shovcled up into a Steubner steel bucket, hoisted by a der-



SPOIL BANK AND TRESTLE CARRYING MUCK CARS FORM 51st St. SHAFT



PLANT LOCATION AT WOOD STREET SHAFT

rick. The excavation progressed at the rate of 3 or 4 linear feet per day through the clay and about .75 foot through the rock, which was drilled with an average of about 30 holes.

The six holes in the center of the shaft were arranged in a circle of about 4 feet diameter, and were inclined together downward to make the first cut and throw out a conical mass of rock for the beginning of each lift.

The rock was seamy and irregular and it was sometimes necessary to reload the holes and fire them again or to drill new holes and blast a second time to make the initial opening. Afterward the other holes drilled around the circumference of the shaft and intermediately were usually charged with two or three half-pound dynamite cartridges and fired in perhaps half a dozen successive shots.

The drilling was done with steels 4 and 6 feet long, operated by five jackhammer drills. The rock was broken into small fragments and loaded into ½-yard buckets.

At the Wood St. shaft several small wooden buildings were provided for the installation of construction equipment and for storage. A simple wooden head tower about 40 feet high was built over the shaft to provide for the operation of the elevator cage, which was suspended by a wire cable passed over the top of the tower and down to the hoisting engine in the adjacent building. Adjacent to the tower was a wooden trestle viaduct carrying a narrow-gage track for the muck cars that were pushed by hand down a very light grade to the spoil bank, where they were dumped.

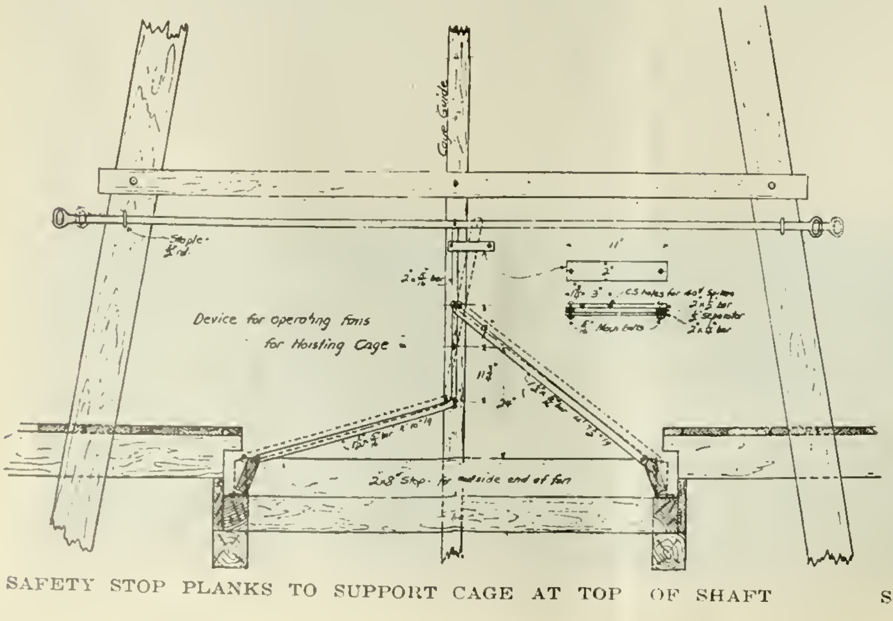
In the rock excavation the shaft was unlined, but above the surface of the rock it was lined with a cicular wall 12 inches thick in sections about 6 feet high, concreted as the excavation progressed.

Each shaft is equipped with two elevator cages, each having a 5 x 7½-foot floor platform with a heavy framework bolted to vertical angle iron side frames about 8½ feet high, provided at each end with riveted sockets receiving the extremities of an 8 x 12-inch wood head block that was also braced to the side frames and carried at the center an eyebolt connection for the operating cable. The side frames on each side were covered by 2-inch horizontal boards to prevent any portion of the cage load from projecting against the sides of the shaft.

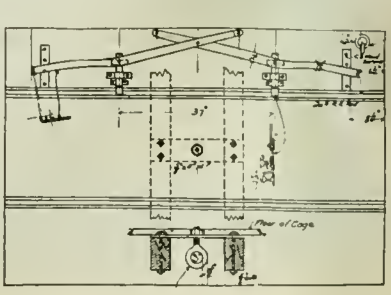
The gate was operated between a pair of 5½ x 7½ inch vertical guides 5 feet 1 inch apart in the clear. The guides were spliced through shiplap joints and were bolted to horizontal frames 7 feet apart that engaged the circular concrete lining and maintained the position and rigidity of the guides. The cross flanges were made of 8 x 10-feet horizontal timber, with the corners fitted to bearing against the surface of the concrete lining and connected by inside 6 x 6-inch angle lugs.

A section of the 24-inch gage service track, corresponding to that on the viaduct, was laid across the floor of the cage to engage the tunnel track at the bottom of the shaft and the spoil track at the top of the tower. After the muck cars were spotted in the cage a pair of stop bars, operated by hand gears, were set to lock the wheels in position to keep the car from rolling to either edge of the cage.

When it was desired to stop the cage at the surface of the ground a pair of stop planks connected by a toggle lever were thrown from a vertical to an inclined plane so that their upper edges were moved towards each other and directly under the floor of the cage, allowing the latter to rest on them and holding it securely in position regardless of the hoisting cable. When it was desired to lower the cage, it was slightly lifted to free it from the stop planks, which were then revolved to the raised position shown in the engraving and cleared the cage, which could then be under the control of the hoisting line. The planks, being securely engaged to the shaft framing, provided a very simple and a solid support for the

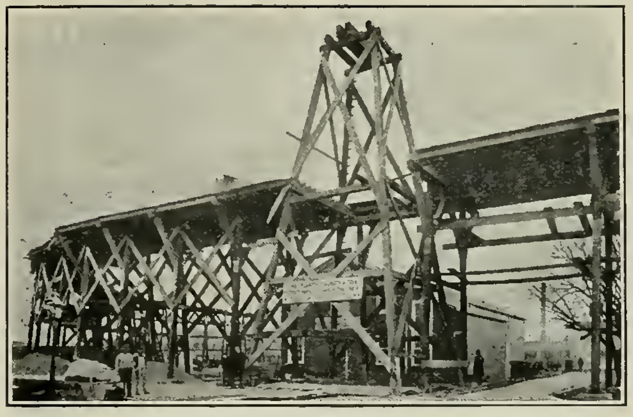

Cage Guide
Staple Rod
Device for operating fans for Hoisting Cage
2x8 Stop for outside end of fan

SAFETY STOP PLANKS TO SUPPORT CAGE AT TOP OF SHAFT



STOP FOR TUNNEL CARS ON CAGE

STAVE LINING OF SHAFT 43 FEET DEEP TO SURFACE OF ROCK



HEAD WORKS AND MUCK TRESTLE AT WOOD ST. SHAFT

could be instantly operated from either side of the shaft.

The arrangements of the 51st Street shaft were substantially like those at West Street, except for different positions for the spoil bank, the muck track forming a complete loop, as shown in the illustration on the first page.

The shafts were sunk under the direction of G. F. Samuel and N. P. Steck, resident engineers. J. J. Verslius, engineer of waterworks construction, and Alexander Murdock, city engineer.

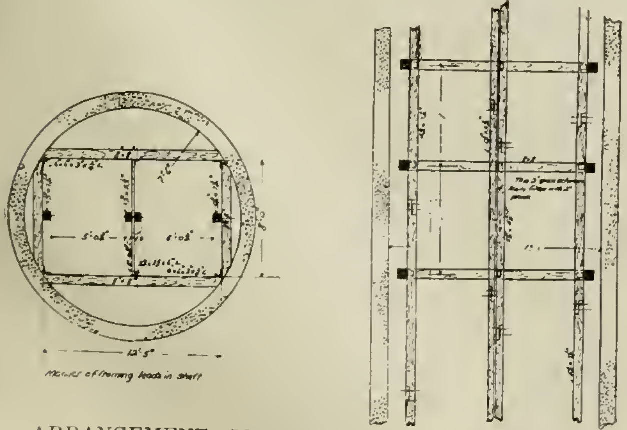
Possibly the Blue Prints

An amusing display of unbelievable credulity that is entitled either to a reward for its absurdity or to resentment as an insult to common intelligence, is the "special dispatch" recently published in the *San Francisco Chronicle* that gravely informs a defenseless world that all the material except the floor for the 240-foot suspension bridge to span the Trinity river, has been shipped from Sacramento to the bridge site by parcel post! We would respectfully suggest that it would make a much better story, and quite as credible, to have exercised a little originality and to have seriously averred that Trinity river and the bridge site were shipped to Sacramento, the bridge washed into place over it, and the combination shipped back again all by parcel post or by telephone—Its a good story if you don't weaken.

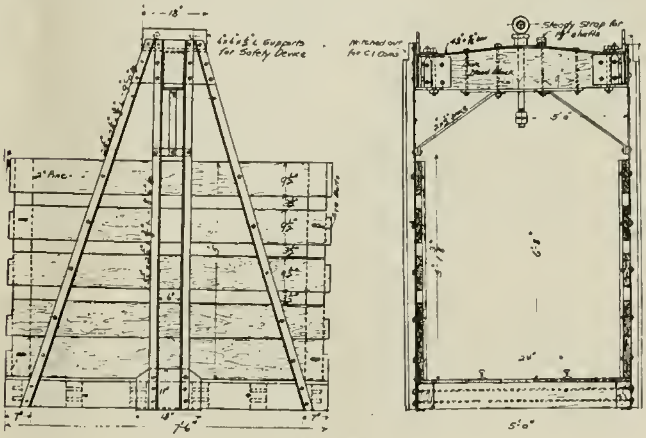
Difficult Sewerage in Ystradgynlais

American sewerage engineers have their own difficulties to contend with, but among them are not included the necessity of operating in towns with names similar to that given above. An English magazine, "Municipal Engineering and the Sanitary Record," describes a system recently built in a town of that name in which there were other difficulties besides that or pronouncing the name. Although the population is under 10,000 and less than 8½ miles of sewer were laid, it was thought necessary to lay lines of sewer under the river in four places, under 6 separate railroad crossings and under a canal in two places.

It may be that the hilly topography of this Welsh town called for this great number of expensive crossings of waterways and railroads, but it hardly seems conceivable that the ingenuity of an American engineer would not have enabled him to eliminate at least half of them. River and canal crossings are generally not only expensive to construct but also difficult to maintain properly and are to be avoided wherever possible.



ARRANGEMENT OF GIRDERS AND BRACES FOR ELEVATOR CAGE.



DETAILS OF HOME MADE CAGE

Municipal Ownership of Water Works

In a paper read before the Public Ownership League of America by R. E. McDonnell of the firm of Burns & McDonnell, the author states that municipal ownership of water works is rapidly becoming almost universal, giving as the chief cause of the change from private to municipal ownership the desire of cities to "improve the service and to secure good, pure, soft water at a reasonable cost. This American cities are doing. There are now about 5,000 municipally owned water plants in the United States, or about five-sixths of all the water supplies are owned by cities. In comparing the people served, it is safe to say that 90 percent of the nation's urban population gets its drinking water from municipal works. The proportion of municipal water plants throughout the country is shown by the statistics of a few of the states. South Dakota has 100 percent of its water plants municipally owned; Nebraska has 99 percent; Kansas has 96.3 percent; Minnesota has 96.4 percent; Oklahoma has 93.1 percent; and Iowa has 91.2 percent."

Among the advantages of municipal ownership Mr. McDonnell refers to the lower interest paid on loans by municipalities, the reduction of incentive to corruption and graft, and the lower rates possible. Concerning the second, he quotes Francis J. Heney as saying: "After five years of investigating the causes and cure for graft, I bring this one message; I am driven to believe that the public ownership of public utilities is the only cure for graft." Municipal ownership as a rule provides better working conditions, shorter hours and better wages, and consequently fewer labor troubles, strikes in municipal plants being practically unheard of.

"We would not think of placing our fire and police departments under private ownership for profit. These are for the protection of property. Then why have our water departments operated under such conditions?"

"Under war conditions, while nearly all privately owned utilities were clamoring for increased rates, 85 percent of the municipal plants maintained their rates and a few actually reduced them. The municipally owned water plant usually gives rates encouraging industries and promotes expansion of all activities. The records of water rates in the cities that have changed ownership show that within two years after changing an average reduction of 27 percent has occurred."

"If the municipal authorities are to be held responsible for the health conditions, they should have complete ownership and control of the water supply, which is the most important factor in the health, growth and prosperity of any city."

To Abolish Boards of Health

Chapter 249 of the Laws of 1921 of New York State permits every second and third-class city by ordinance to abolish its bureau or board of health and to create and maintain in its place a department of health with a single head appointed by the mayor. This law has the approval of the State Department of Health. Amsterdam is the first city to abolish its board of health under this law. Previous to the enactment of this law, Syracuse and Yonkers by special laws abolished their bureaus of health and established departments.

Corrosion of Underground Pipes

Under this head the Journal of the American Institute of Electrical Engineers tells of an investigation being conducted by the Bureau of Standards cooperating with the American Committee on Electrolysis, the manufacturers of iron and steel pipes and representative of public utilities companies. Water works associations and associations of gas works officials have been quite interested in this investigation, the main if not the sole purpose of which is to determine the effect of electrolysis upon underground pipes. The only mention of electrolysis made by the journal referred to, however, is the name of the Committee on Electrolysis, but it refers to the investigation as being stimulated by "a very serious condition in connection with underground pipe systetms owing to the corrosive action of the soil upon the iron of which the pipe is made." The investigation is said to be made "with particular reference to the corrosive action of soils on gas and water mains."

The article remarks that "the results of the tests should be of great value in determining the importance of soil corrosion and in selecting the kind of pipe best suited for use in any particular soil." It is amusing to notice the care with which the writer of the article avoids all reference to electrolysis as being the real source of the destruction of the pipes which is being investigated. One rather wonders, however, what excuse he can have for giving this article a prominent place in a paper devoted to the interests of electrical engineers if the only matter involved is soil corrosion of water and gas pipes.

Sewer Bids in Winona

Winona, Minn., on November 28th, received bids for sewer construction estimated by the city engineer, E. E. Chadwick, to cost $75,489. A large number of contractors were present at the opening of the bids and ten bids were received. It is reported that remarks made by the various contractors indicated that they were all eager to obtain work that could be done in the winter and to employ as many men as possible on it, and each gave assurance of an early start if the work was awarded him. The bids varied from a minimum of $55,625 to a maximum of $92,800. One other contractor was below the engineer's estimate by about $500.

Points of interest in this letting were the considerable number of contractors present at a letting in a small city of a work of moderate size; the apparent desire to obtain winter work for laborers; and the fact that two of the contractors were below the engineer's estimate. As to the last, it has been noted at a number of lettings during the past two or three month that bids have been made below the engineer's estimate by a greater amount and in a greater number of cases than has ordinarily been experienced. This was probably to be expected because of the continual falling of prices and wages after the estimates were made by the engineers. Indications are, however, that most prices and wages have about reached rock bottom and in fact some have begun to rebound slightly, so that this condition will probably not be so common during the next few months as it has been during the last few.

Teredo Protection for Wooden Piles

The new ocean dock at Port Orford, Ore., has a foundation of fir piles, 55 feet long, that are located in water infested by the Teredo that, under favorable conditions can entirely destroy wooden piles in a year or even less.

The bottom is of clay so hard that it was necessary to blast preliminary holes about 4 feet deep with dynamite before these piles were driven, after which 125 of them were enclosed with cylinders 24 inches in diameter made of galvanized corrugated Armco ingot iron, dipped in a special asphaltic solution and driven with 8-inch strokes of 650-pound hammer. The cylinders were made of No. 14 gage iron and the successive sections were field riveted together instead of receiving the ordinary corrugated iron coupling bands. After the cylinders were put in place the annular spaces between them and the wooden piles were filled with cement concrete, poured under water through an 8-inch pipe.

Planning Sewage Disposal for Small Municipalities

Outline of data that should be considered in preparing plans, nature of conclusion that should be derived, and relations between conditions and types of plant suitable thereto.

In a paper before the A. S. M. I. entitled "Sewage Disposal for Small Municipalities," John F. Skinner, principal assistant city engineer of Rochester, N. Y., presented a very complete synopsis or outline of the data that should be considered, the nature of the conclusions to be derived from such data, the types of plants applicable under certain conditions and the functions performed by each, all arranged in tabulated form. Finally, at the conclusion of the paper, he presented certain observations relative to small sewage treatment plants.

In this outline an effort was made apparently to include every feature likely to be encountered, although it would not be probable that all or even a very considerable percentage might apply to any one case. Mr. Skinner, indeed, states that only one principle could be postulated that will apply to all cases, this being that "each situation is a distinct problem to be studied and solved truthfully; always remembering that the truth upon any subject is obtained by marshalling all the facts in their proper relations."

The outline presented by Mr. Skinner will probably be helpful not only to young engineers with little or no experience in designing plants, but also as a check list or reminder to engineers of wider experience. The outline is given below.

DATA TO BE CONSIDERED

1. Physical Conditions.

- A. *Area of Territory.*
  - (a) Present.
  - (b) Future.
- B. *Character of Territory.*
  - (a) Compact or scattered.
  - (b) Residential, commercial or industrial.
  - (c) Flat or hilly, gentle or steep slopes.
  - (d) Low, requiring pumping, or high, allowing gravity outfall.
  - (e) Geology, sand, gravel, clay, quicksand, rock.
- C. *Population, Density and Total Numbers.*
  - (a) Present.
  - (b) Future.
  - (c) Resident.
    - a. Home and Business.
    - b. Home only (commuters).
  - (d) Non-resident (industrial).
  - (c) Seasonal (Summer colony).
  - (f) Transient (Summer resort).

2. Sewerage System.

- A. *Character of Sewer System.*
  - (a) Separate.
  - (b) Combined.
- B. *Amount of Sewage.*
  - (a) Dry weather flow } Obtained by:
  - (b) Maximum flow
    - a. Amount of water supply and population.
    - b. Sewer gaugings.
    - c. Proportion of stormwater admitted in case of a combined system.
    - d. Precipitation, run-off data, % impervious, etc.
- C. *Character of Sewage.*
  - (a) Domestic waste.
  - (b) Industrial waste.
    - a. Solids d. Source.
    - b. Color. e. Chemical constituents.
    - e. Odor f. Temperature.
  - (c) Ground water.
  - (d) Street wash (in case of combined system) quauntity of manure, leaves, grit, etc., received through surface sewers.
  - (e) Settleable and suspended solids with their settling rates.
  - (f) Effect of various precipitants, especially in the case of preponderating trade wastes.
  - (g) Oxygen demand—putrescibility.

3. Body of Water Receiving Effluent of Plant.

- A. *Non-Potable, no bathing.*
- B. *Salt water with beaches to protect.*

C. *Tidal stream—bathing.*
D. *Fresh water lake.*
  (a) Bathing.
  (b) Water supply.
E. *Fresh Water Stream.*
  (a) Large or small.
  (b) Riparian uses.
  (c) Industrial uses.
  (d) Bathing.
  (e) Water supply.
F. *State Regulations Regarding Discharge of Sewage.*
G. *Currents—Dilution and Dispersion.*
H. *Deep or Shallow.*
I. *Constant or Variable Level.*
  (a) Fluctuation due to tides.
  (b) Fluctuation due to precipitation.
  (c) Fluctuation due to storage.
J. *Temperature*—Water and Sewage.
K. *Wind*—Prevailing Direction and Intensity.
L. *Vegetation.*
M. *Pollution other than by this Effluent.*
N. *Protection of Fish, Oysters, etc.*
O. *Visual and Aerial Nuisance.*

4. Funds Available for Sewage Treatment.

II.

CONCLUSIONS FROM THE DATA

1. Volume of Sewage to be Treated.

A. *Dry Weather Flow*—Present and Future.
B. *Maximum Flow*—Present and Future.
C. *Distribution*—Through Day and Week.

2. Character of Sewage.

A. *Variation in Density.*
B. *Solids*—Settleable and Suspended.
C. *Oxygen Demand*—Putrescibility.
D. *Color, Odor, etc.*

3. Character of Treatment Indicated.

A. *Discharge into Non-Potable Water.*
  (a) Remove floating and coarse* suspended objects.
  (b) Remove grit where necessary to prevent deposits in stream, lake or long outlet pipe.
B. *Discharge into Small Non-Potable Stream.*
  In addition to "(a) and (b)" above treat further sufficiently to prevent nuisance.
  (c) Remove settleable solids and 40 to 90% of suspended solids by tank treatment.
  (d) Oxidize effluent.
C. *Discharge into Large Potable Stream or Lake where there is ample Dilution and Oxidation. Treat as in* (a) (b) and (c). "(c)" may be omitted if the effluent does not appreciably effect the receiving body of water.
  (e) Disinfect the effluent when sewage pollution, possible from the effluent, can be detected near bathing beaches or water works intakes.
D. *Discharge into Small Potable Stream or Lake.*
  Treat as indicated in "(a) (b) (c) (d) and (e)" above.

III.

TYPE OF PLANT APPLICABLE

The above operations may be accomplished respectively by means of the following devices:

(a) Remove floating and coarse* suspended objects by coarse racks, fine racks or mechanical screens.
(b) Remove grit by detritus chambers.
(c) Remove settleable solids and 40 to 90% of suspended solids by tank treatment with or without precipitants.
(d) Oxidize effluent by irrigation, sand filtration, contact beds, trickling filters, or aeration or activation.
(e) Disinfect the effluent by liquid chlorine or bleach.

IV.

ELEMENTS OF DISPOSAL PLANTS

1. Removal of Solids.

A. *Screening Devices.*
  (a) Coarse racks: Bars 2" to 4" apart for large objects in combined sewage.
  (b) *Fine racks*: Bars ¾" apart for coarse floating and suspended matter in fresh sewage, when followed by tank treatment.
  (c) *Fine mechanical screens*: For coarse floating and suspended matter, particularly in the case of stale or septic sewage when followed by further treatment. The removal is mainly garbage. Also where no further treatment is required, as above in II—3—A and C.
B. *Detritus Chambers*: For the removal of grit and heavy (mainly inorganic) solids which will settle from a stream flowing at a mean velocity of one foot per second. This should precede fine racks or screens; more important for combined sewage.
C. *Tanks*: For the removal of settleable solids and 40% to 90% of suspended solids.
  (a) Sectic tanks, 8 to 12 hours detention.
  (b) Biolitic tanks.
    a. Agitation chamber 6 to 8 hours detention.
    b. Settling chamber 2 to 3 hours detention.
  (c) Imhoff tank.
    a. Flow chamber—3 hours mean detention for best removal.
    b. Digestion chamber—4 to 6 months sludge.
  (d) Settling tank—3 hours mean detention with continuous removal of sludge for separate digestion, with or without a precipitant.

2. Oxidation of Effluent.

A. *Dilution* in Lakes or Streams.
B. *Broad Irrigation*: Only applicable under unusual conditions of isolation and cheap land.
C. *Sand Filters*: Only applicable where large areas of natural sand and gravel are available in suitable location.
D. *Contact Beds*: For locations so close to habitations that the spray from sprinklers would cause nuisance.
E. *Trickling Filters*: Of broken stone or brush. This is probably the best known method of artificial oxidation of tank effluent. When carefully designed and constructed they have been uniformly successful on well settled sewage which does not contain unusual elements, trade wastes, etc. They are expensive to construct but cheap to operate. They should be followed by settling basins for secondary sludge.
F. *Aeration or Activation*: The process known as "Activated Sludge" produces a well oxidized effluent by means of agitation and thorough mixing of sewage, air and previously aerated sludge. It is a plant relatively cheap to install but most expensive to operate. It requires less area than any other artificial method of oxidation but it is limited to situations where cheap power is available, where fertilizer can be produced as an offset to the expense of operation and upon a large scale. Certain adaptations still in the experimental stages offer promise of success.

3. Disposition of Solids.

A. *Screenings.*
  (a) Incineration.
  (b) Composting for fertilizer.
  (c) Treated as garbage.
    a. Buried.
    b. Burned.
    c. Reduced.
B. *Grit*: Dumped for filling.
C. *Sludge.*
  (a) With or without digestion.
    a. Dumped in deep water or discharged during flood conditions.
    b. Lagooned or dried in furrows and covered.
  (b) With digestion: Drained on drying beds and used
    a. For fertilizer.
    b. For fertilizer base.
    c. For filling.

4. Disposition of Effluent.

A. *Direct* in to receiving Body of Water.
B. *Through Long Conduit* to avoid local pollution.
C. *Chlorination* where necessary with
    a. Liquid chlorine or
    b. Bleach.
  To Protect
  (a) Water supply.
  (b) Shell fish.
  (c) Bathing beaches.

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*Without entering into controversy as to the amount removable by screens, in this paper, **coarse** solids are distinguished from **fine** in that the latter are best removed by sedimentation or precipitation.

V.
OBSERVATIONS

There are certain details in the construction and operation of disposal plants which are too often overlooked, as they are generally omitted in the literature of the subject.

Provide the plant, where necessary, with:

1. Water under pressure.
2. Industrial railway.
3. Light.
4. Heat in building for cold weather.
5. Repair shop with forge, pipe cutter, stock and dies and bench tools.
6. Laboratory and apparatus.
7. Power for the above and other uses.
8. Labor under competent supervision.

The moving of sludge, grit and screenings is often most conveniently accomplished by an industrial railroad preferably operated by storage battery locomotives, as this method obviates the danger of exposed trolley wires.

In fortuitous situations, like two of the present and two of the future plants of Rochester, N. Y., *power* is obtained from the fall of the sewage and fuel is only used for heating; otherwise it must be provided and becomes an important element in the expense of the plant.

A certain amount of labor may be effectively employed in hosing and washing down decks and walls, skimming tanks, agitating scum in gas slots by streams or by the use of tamps to prevent the formation of a continuous crust and afford free vent for the gas.

Labor is also required in operating gates, removing sludge, grit and screenings; raking over the surface of trickling filters when the first "ponding" appears, inspecting and cleaning spray nozzles daily as well as the distributing and collecting pipes.

Such operations are most certainly performed when a methodical schedule is maintained and directed by a responsible man on the job.

Flies in large numbers are disgusting around a disposal plant and can be largely avoided by reasonable precautions. As they come to obtain food, they can be discouraged by keeping all surfaces washed clean and by barring floating solids from quiescent water in tanks.

In the relatiively rapid current of a detritus chamber in advance of screens, it is only necessary to keep the walls washed clean. Grit from a properly operated detritus chamber will not attract flies, neither will well digested Imhoff sludge, whether wet, spadable or dry.

Fine screens and efficient scum boards, hosing and occasional skimming will minimize the floating solids in a settling tank, or reduce them to such size that they will not support a fly.

Screenings attract flies as they are largely composed of garbage. They should be covered with grit, earth or ashes or compacted and sprinkled with borax solution.

Small moth flies which are found in warm weather on and above a trickling filter come from the larvae resident on the stones just below the suruface. They do not travel far from the filter and are not objectionable. They may be kept out of other portions of the plant by screening doors, windows and other openings, and by providing curtain walls dipping below the surface of the sewage.

Odors. The best plan is to surround the plant by a large tract of land municipally owned and controlled, but even then certain odors which reach to considerable distances may produce nuisance unless controlled.

Well digested Imhoff sludge is not objectionable and can be noticed only in the immediate neighborhood. Odor from screenings can be controlled by covering as suggested above. Liquid sewage when undisturbed does not give much offence, but when it is broken up in rapid currents by means of baffles or tumbled over weirs, it becomes more noticeable.

Odors have been found objectionable at distances of half a mile when sewage is blown into the atmosphere as spray, by air under pressure.

This nuisance does not occur when the wind direction is unfavorable, nor yet when there is perfect quiet. A strong wind or good breeze does not seem to cause trouble to leeward for the vapor is too attenuated when mingled with a considerable volume of air. Smells seem to be carried furthest with a scarcely perceptible drift of the air.

The remedy for this condition consists in covering so that rising spray or vapor will impinge upon the under surface of the cover and be condensed.

At the Main (Irondequoit) Sewage Disposal Plant of Rochester, N. Y., where the total cost, including the site of 315 acres on the shore of Lake Ontario, was $975,000, and where 45 feet head is available most of the time, the cost of accessories such as water works, railroad, grading, light and power was $108,000.

In general such accessories, including equipment of shop and laboratory, may amount to 10 or 15% of the cost of the plant.

Women Becoming Active in Highway Construction

The surprising extent to which women are invading the field of highway construction is shown by a long list of feminine road builders invited to the American Good Roads Congress to be held in Chicago next January. Among these is Dr. Jennie C. Murphy, the only woman street commissioner in the world, who bosses the construction gangs and street cleaners at Yankton, S. D., and has held the job for several years. Mrs. Axel Holm, of South Range, Wis., road contractor, has just completed 4¼ miles of state highway near Superior, Wis., that forms a part of the great Mississippi Valley Scenic Highway from New Orleans to Canada. Mrs. Holm handles the finances of her company, bosses a gang of 57 workmen, cooks their food and looks after the welfare of her machinery and 20 teams of horses. Two daughters, Vivian and Verna, keep her books and assist her in her work.

Miss Eva Cressey, president and general manager of the Cressy Contracting Co., at Everett, Mass., manufactures road machines that are used in many states for spraying oil, tar and asphlat in road work.

Miss H. M. Berry, of Chapel Hill, N. C., as secretary of the North Carolina Good Roads Association, did much to put over the $50,000,000 bond issue for roads now being constructed in her state.

Dr. Lou Alta Melton is said to be the only woman bridge engineer in the country. She graduated in civil engineering last year at Colorado University and is now connected with one of the district offices of the United States Bureau of Public Roads. She is the only woman engineer in the employ of the Federal Government.

Nimishillen Creek Wall

A long, high concrete retaining wall built with dragline machines that excavated wet trench and afterwards served as locomotive cranes for handling heavy form panels.

The improvement of the Nimishillen creek, Canton, Ohio, included the deepening of the channel 3 feet and the construction alongside of 2,000 feet of concrete retaining wall, with an average height of 18 feet, thickness of 10 feet at base and a 12 x 3-foot footing carried down to a depth of 7 feet below the original creek bottom.

The trench for the footing was excavated by two Osgood, class 18, combination dragline and locomotive cranes, equipped with 40-foot booms and 1-yard excavating buckets.

The ground was so stiff that the sides of the trench stood at a ¼:1 slope without sheeting, thus eliminating the necessity for any sheet piling or bracing in the trench. The machines, being mounted on caterpillar traction, moved safely over the soft ground without tracks or mats and on occasion were rigged with dippers to operate like regular steam shovels. At other times the dragline bucket was replaced by a clam shell or by a simple hoisting tackle enabling the machine to act as a regular locomotive crane.

The large amount of water entering the trench was satisfactorily handled by a 6-inch Morris motor driven centrifugal pump, installed on skids at the lower end of the wall and draining the entire length of 2,000 feet. Besides these regular pumps, two gas driven 4-inch Domestic Foundation pumps, were kept on hand for emergency, but were used on only two occasions.

As the trench was completed the footing was concreted in rough forms and the wall was built on it in sectional wooden forms, made in 26-foot panels, handled by the locomotive crane. The front and rear panels of the forms were made with horizontal boards nailed to vertical studs that took bearing on six lines of walling pieces that projected beyond the ends of the panels to connect with the adjacent panels and were braced by inclined struts with their lower ends engaging steeply inclined plank footings that distributed the pressure on the earth.

The concrete was mixed in a portable machine on top of the bank, which moved along with the work and deposited directly into the forms. After the completion of the wall the Osgood machines were changed back to draglines for backfilling, except in some restricted clearances where they used clamshell buckets.

The work was executed by the Fred R. Jones Co. contractor, who considered the machine used to be very convenient for this style of work on account of its flexibility that enabled it to be operated without mats for miscellaneous work and as a dragline, a locomotive crane, a clamshell excavator or a regular steam shovel as required.

Advertising On Road Signals

Several types of road signals have been adopted for directing traffic on the highways of the country, but it is probably a new idea that the state or county should be able to have these provided and maintained without any expense to them or the tax paying public. However, this is apparently provided for on the Vermont highways by an arrangement just entered into between the American Gas Accumulator Co., of Elizabeth, N. J., the Standard Oil Co., and the Highway Commission of Vermont.

The Accumulator Co. has placed in the market the device known as the "highway lighthouse" and offered to instal these signals and operate them on public highways without cost to the highway authorities if allowed to place advertising on the sides of the standards. The state highway commission of Vermont is reported to have agreed to such an arrangement and the Standard Oil Co. to have arranged with the manufacturer to advertise its products on these standards for a period of three years, under such terms, we presume, as to make it worth while for the Accumulator Co. It is said that the cost of the "lighthouse" is about $400 each in small lots. The cost of erecting it and keeping it in gas and repair is not stated. Between 2,000 and 5,000 of the signals are to be placed on the Vermont highways, some bearing the words, "Warning, Railroad Crossing," "Warning, Curve," etc., and also the number of the route on which the signal is stationed and the distance from the nearest city.

Building 7.63 Miles of 18-Foot Concrete Highway in 67 Days

An unusual record for uniformly rapid construction of a long piece of concrete highway has been made by Rogers Bros. Co., Los Angeles, Calif., in the construction of a section of the Taft-Bakersfield Highway in Kern County, Calif., where 40,346 linear feet of highway, containing 13,065 yards of concrete were finished in 67 lapsed days after the beginning of the work early in 1921. The old concrete pavement 4½ inches thick and 15 feet wide, was covered by a new surface 5 inches thick and extended on each side for a distance of 1½ feet with a thickness of 9½ inches adjacent to the shoulder 3 feet wide on each side of the pavement.

A section of the road 3,000 feet long was 22 feet wide and on a 7 per cent grade, another 2½ miles was composed of various curves and grades, and 5 miles are on tangents. All materials were unloaded from the railroad cars by a Thew steam shovel, equipped with a clam shell bucket and travelling on a crane track parallel to the railroad siding. The clamshell loaded a maximum of 22 motor trucks that handled an average of 300 tons of aggregate daily, hauling it an average distance of 5 miles with the long grade in favor of the load.

The trucks worked from 5 A. M. until 7 P. M. or until dark, dumping their loads on the surface of the old road adjacent to the mixer, which was served by wheelbarrow gangs.

The forms were set at an average rate of 1,200 linear feet daily by a crew of variable size working one shift. The 4½-bag batches of 1:2:4 concrete were mixed in a new 21-E Foote machine operated on a double shift basis by two crews that worked from 5 A. M. to 10 P. M. with two ½-hour lunch intervals.

The surface was tamped and finished by hand and was cured by water impounded between earth dikes on both sides of the pavement and built across it at intervals corresponding to the grade.

Concreting was commenced March 26th and completed May 12th and allowing for Sundays and a number of days and half days when one or both of the shifts were idle, the actual time of concreting was 584 hours, giving an average of nearly 23 yards per hour for the entire time, or 69 linear feet per working hour. The best day's work was April 14th when one shift laid 744 and the other shift laid 730 linear feet of pavement, making a total of 470 cubic yards.

Two hundred and forty working days one shift averaged 587.6 and the other shift 509 linear feet per day, making an average total of 158 cubic yards for each 16-hour day.

Wood Block Pavement After Fifteen Years of Service[*]

By J. D. MacLean[†]

Relative wear of the several species of wood laid on a Minneapolis street by the city and the Forest Service, effect of length of block and angle of joint.

In 1906 an experimental treated wood block pavement was laid by the city of Minneapolis in cooperation with the Forest Service.[‡] This experiment was undertaken to study the following variables:

(1) The relative merits of different species of wood for paving block material.

(2) The effect of the length of blocks on the wearing qualities of the pavement.

(3) The influence of heartwood and sapwood on durability.

(4) The relative wear on blocks laid at different angles.

A detailed description of the material used, method of treatment, and construction of the pavement is given in Forest Service Circular 141, "Wood Paving in the United States," by C. L. Hill, issued March 4, 1908, and in Forest Service Circular 194, "Progress Report on Wood Paving Experiments in Minneapolis," by F. M. Bond, issued January 16, 1912.

Other published information relating to the work is as follows:

"Experiments with Wood Paving Blocks," by C. H. Teesdale, "Municipal Journal," of May 6, 1915. (Illustrations with this article show arrangement of different species of wood in the pavement and cross-section of pavement,—Editor.)

"Progress Report on Wood Block Paving Experiments in Minneapolis," by C. H. Teesdale and J. D. MacLean—Proceedings of American Wood Preservers' Association, 1919.

DESCRIPTION OF THE PAVEMENT

Sections containing Douglas fir, hemlock, longleaf pine, Norway pine, tamarack, western larch, and white birch, were laid on Nicollet avenue, between Washington avenue and Second street. This portion of the street is subjected to continuous heavy traffic and the different species were placed in this location to study the relative value of each wood for pavement material.

In addition to the sections laid with the different species, three sections of Norway pine blocks were laid on Nicollet avenue, north of the intersection of Second street. These sections were laid at angles of 90 degrees, 45 degrees, and 67½ degrees with the curb for a comparison of wear on blocks laid at different angles. The blocks in the sections containing the different species were all laid at an angle of 67½ degrees with the curb.

All curbs in the experimental pavement were 4 inches deep and 4 inches wide. The lengths of the blocks of the different species were as follows:

Longleaf pine, variable	6 inches to 10 inches
Norway pine, variable	6 inches to 10 inches
Tamarack, variable	6 inches to 10 inches
Douglas fir, variable	6 inches to 10 inches
Hemlock	6 inches
Western larch (one-half of section)	6 and 8 inches
Western larch (one-half of section)	4 inches
White birch (one-half of section)	6 and 8 inches
White birch (one-half of section)	4 inches

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[*] Paper before American Society for Municipal Improvements.

[†] Engineer in Forest Products, Forest Products Laboratory, Madison, Wis.

[‡] Special acknowledgement for assistance in the experiment is due to the City Engineering Department of the city of Minneapolis and the following companies cooperating in the work; The Republic Creosoting Company and the Kettle River Creosoting Company of Minneapolis, The John Week Lumber Company of Stevens Point, Wisconsin, The Cloquet Lumber Company of Cloquet, Minnesota, The Larson Lumber Company, Bellingham, Washington, and the Westside Lumber and Shingle Company, Portland, Oregon.

The blocks were placed on a one-inch sand cushion over a five-inch cement foundation. One-inch expansion joints were provided at each curb and partially filled with sand. The body joints and the top of the expansion joints were filled with a pitch filler, after which a sand dressing was placed over the finished pavement.

TRAFFIC CONDITIONS

Although the street is fifty feet wide, parking of automobiles along the curb causes the traffic to be concentrated along the central part of the pavement so that about one-half the total width of the street receives most of the wear. This is particularly true of that portion of the pavement between Washington avenue and Second street, where the sections containing the different species are located. The three sections of Norway pine north of the intersection of Second street, which have blocks laid at different angles, do not appear to be under such severe wear as those in the other sections. This is probably because traffic is distributed over a greater width of the pavement, on account of fewer automobiles being parked in this area, and on account of the shorter distance between intersecting streets.

The following traffic census,* taken from 7:30 a.m. to 7:00 p.m. on June 27, 1921, gives an indication of the amount of traffic passing over the experimental sections which contain the different species.

Kind of Vehicle	Number
Steel tires	165
Bicycles and motorcycles	142
Automobiles	3,501
Trucks	717
Total	4,525

INSPECTIONS

Annual inspections have been made since the wear developed sufficiently to show progress of deterioration. On account of the pockets and depressions of different sizes and shapes that develop as the time of service increases, a very satisfactory measurement of the wear cannot be made. However, in order to make a comparative estimate of the relative wear on the different sections, the following method was adopted:

(1) An estimate of the total number of square feet in a section below the general level was made.

(2) An estimate was made of the total number of square feet in a section, ½ inch or more below the general level of the street.

(3) Measurements were made on individual blocks to determine the average wear.

The estimates of the area of depressions below the general level of the surface were made independently by each member of the inspection party, after which the estimates were averaged and recorded. When depressions are not extensive, such estimates can be made with a fair degree of accuracy, but as the depressions become more numerous, greater difficulty is experienced and wider variations are to be expected. While it is difficult to make close estimates of the area affected by depressions, particularly as these areas increase to considerable proportions, the average estimates, however, furnish a means of determining the relative condition of the different sections.

In order to correct as much as possible for variations in estimates made in different years, the data were plotted and average curves drawn as shown in the accompanying illustration.

The measurements of wear were made on blocks taken from the central part of the street where the surface was thought to be fairly representative of the wear in the section.

RESULTS

All of the species originally placed in the pavement are still in service except the Douglas fir blocks, which were removed in 1911. It was necessary to re-lay the section containing this species after five years' service, as some of the blocks were broken and deep depressions had formed over a large area of the section. The early failure of this wood was probably due to a poor quality of material used in the original construction. For a further test of this species a part of the same section was re-laid with a better quality of wood. Only a limited supply of these blocks could be obtained at the time and the remainder of the section was therefore paved with the standard yellow pine blocks furnished by the city.

RELATIVE WEAR OF SPECIES

The curves in the illustration give a general indication of the relative wear of the different species in the test. Since the Norway pine blocks in sections 12, 13 and 14 are not under the same conditions of wear as blocks of the other species in sections 1 to 10, the curves representing the percentage of depressions are shown separately above the other curves.

White birch and longleaf pine.—Both the white birch and longleaf pine are in distinctly better condition than any of the other species. However, the white birch sections have deeper depressions than the longleaf pine and their condition is not quite as good as that of the pine. This is mainly on account of decay pockets that were present in some of the birch blocks at the time they were laid and the defective material was not discovered until after it had been in service a short time. For this reason a few decayed blocks have been removed from the white birch sections. If the unsound blocks had been eliminated before the pavement was laid the birch would probably have shown about the same durability as longleaf pine.

Norway pine.—About one-half of the section originally laid with this species has been replaced during the last two years on account of wear. The section containing these blocks is a small triangle and is situated at the intersection of Washington avenue and Nicollet avenueu. In this location all of the blocks are under very severe wear on account of the heavy southbound traffic and the turning of trucks and other vehicles at Washington avenue. Sections 12, 13 and 14 are no doubt more representative of the wearing qualities of this species and the good condition of these sections would indicate that Norway pine paving blocks may be expected to give very good results.

Eastern hemlock and tamarack.—There does not seem to be a marked difference in the condition of the sections containing these two species. While the hemlock blocks are apparently in slightly better condition than the tamarack, the difference is not of particular importance.

---

*Data furnished by Mr. Ellis R. Dutton, Asst. City Engineer.

Western larch.—The sections laid with western larch have deeper and more extensive depressions than sections laid with the other species. Apparently the sections paved with this wood will require renewal before those paved with the other woods.

Douglas fir.—Since the blocks of this species have only been in service for 10 years, as compared with 15 years for the other species, a good comparison of this wood cannot be made. While no deep depressions have developed up to the present time, the progress of deterioration is becoming more noticeable each year through the increased area affected by depressions and the amount of wear as determined by measurement of the blocks. From the fact that these blocks have been in service twice as long as those replaced in 1911, it is evident that the first material was not of the best quality.

The longleaf pine blocks, laid adjacent to the Douglas fir material in 1911, are practically free from noticeable depressions.

MEASUREMENTS OF BLOCKS

Measurements made in July, 1921, by Mr. Dutton, to determine the average wear, showed the approximate decrease in depth of blocks of the different species in sections 1 to 10 to be as follows:

Longleaf pine after 15 years' service....	1/2 inch
White birch after 15 years' service..........	9/16 inch
Norway pine after 15 years' service..........	9/16 inch
Tamarack after 15 years' service...........	5/8 inch
E. hemlock after 15 years' service...........	11/16 inch
Western larch after 15 years' service........	11/16 inch
Longleaf pine after 10 years' service.........	5/16 inch
Douglas fir after 10 years' service...........	1/2 inch

Careful observations of the surface of the pavement showed that blocks from the wide ring or rapid growth material seem to be withstanding wear as well as those from the slower growth wood. This was particularly noticeable for the larch, hemlock, birch, and pine blocks in which the number of rings per inch was quite variable.

EFFECT OF LENGTH OF BLOCKS

The length of the blocks used in this experiment varied from 4 inches to 10 inches and the results seem to indicate that the length was not an important factor affecting the wearing qualities of the pavement. Whatever difference in wear may be noted between blocks of different length is comparatively unimportant and is probably due to other causes.

INFLUENCE OF HEARTWOOD AND SAPWOOD

In the material used for this experiment the longleaf pine, Douglas fir, and western larch, were practically all heartwood. The Norway pine and tamarack were mixed heart and sap. Heartwood and sapwood were indistinguishable in the white birch and hemlock blocks.

Results of the experiment do not appear to show any particular influence of either heartwood or sapwood on wearing qualities. Decay was found in the sapwood on some of the blocks but where this was the case the blocks had apparently not been well treated.

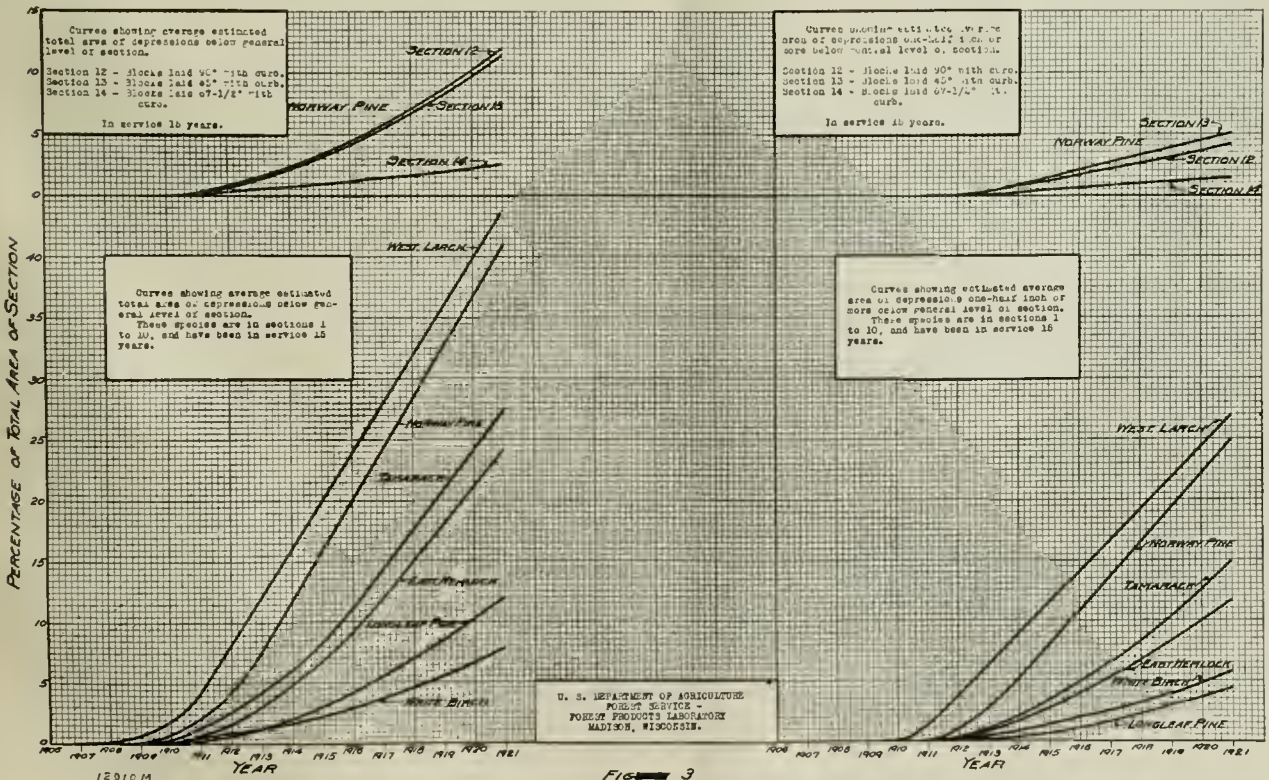

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FIGURE 3

ESTIMATED TOTAL AREA OF DEPRESSIONS BELOW GENERAL LEVEL

Comparison of different woods, and of Norway pine, each at different angles with the curb.

COMPARISON OF ANGLE OF COURSES

Section 12, laid at 90 degrees with the curb, shows greater joint wear than sections 13 and 14 which are laid at 45 degrees and 67½ degrees respectively. The courses laid at 67½ degrees are in slightly better condition than those laid at 45 degrees. These blocks, however, are at the junction of Hennepin avenue and Nicollet avenue, and traffic is distributed over a larger portion of the surface. Under exactly the same conditions it is probable that little, if any, difference would be found in the relative joint wear of blocks laid at 45 degrees and 67½ degrees.

SUMMARY

Beginning with the species showing the best results (placed in sections 1 to 10) the order of efficiency so far shown in this experiment is as follows:

(a) Longleaf pine and white birch.
(b) Eastern hemlock and tamarack.
(c) Norway pine.
(d) Western larch.

If the Norway pine blocks had been under conditions similar to those in which the other species were placed, this species would probably come next to longleaf pine and white birch in order of efficiency of service.

Since the Douglas fir has not been in service for the same length of time as the other species, a good comparison cannot be made. However, the depressions and wear in blocks of this species is very marked in comparison with the longleaf pine blocks laid at the same time.

There was no evidence to show a difference in the rate of wear in blocks of different length.

A comparison of the wearing qualities of blocks with and without sapwood did not show that the presence of sapwood was detrimental.

Sections laid at 45 degrees and 67½ degrees did not show as much joint wear as the section laid at 90 degrees with the curb.

Blocks of wide and narrow rings seemed to be withstanding wear about equally well.

Disposing of Used Plant in Miami Conservancy District

The approaching completion of more than twenty-five million dollars worth of excavation and concrete construction in the Miami Conservancy District, Ohio, gives prominence to the dispositon of more than one mllion dollars worth of the mechanical plant and a vast amount of equipment that has been accumulated during the five or six years that the work has been in progress in a dozen different localities in the Miami Valley.

Large equipment like $40,000 dragline excavators, steam shovels, locomotives, concrete mixers, dump cars, hoisting engines and the like, most of which are yet to be placed on sale, are repaired if necessary and carefully examined and appraised by the master mechanic. Smaller articles are valued in accordance with the current prices of the dealers, mail order catalogs and original costs, with proper consideration of deterioration and a fair price fixed at which they are being disposed of. Purchasers are secured by advertising and by personal and circular solicitation, and many of the smaller articles, especially those derived from the labor camps, are sold locally. A recent report of two sales included 275 different items, many of them of an almost domestic character, such as used hip boots, stoves, playing cards, cash register, miscellaneous large and small articles, which sold for the total sum of $5,691.16.

In selling the labor camps, the timber and the scrap lumber and much of the tools, hardware and mess hall equipment have been advantageously disposed of to local farmers and the remainder transferred to the central warehouse for storage and sale. A number of buildings have been sold at auction, the water supply for camps has been sold in place and tracts of land have been sold to homeseekers.

Effective work has been done by systematized combing of the junk heaps, repairing some of the damaged discards found there, and using others to make spare parts for assembling new articles such, for instance, as wheelbarrows, three damaged ones often sufficing to make two good ones. Two men equipped with an automobile and an acetylene torch salvaged 1,693 cable clips from piles of discarded rope, painted them and provided new U-bolts, thereby effecting a saving of $438. A very important item of salvage was valves, many of which were discarded because of small defects that were easily remedied, making the valves efficient for continued service. The total amount of the small savings that can thus be effected is indicated by the fact that the conservancy commission purchased about 3,000 valves 2-inches in diameter or at a total value of about $10,000, 580 axes, 23,550 cable clips, 300 sledge hammers, 900 picks and other supplies in prpoortion.

Much of the damaged equipment and supplies of course became hopeless junk and were sold as such. Excellent judgment is required to determine when an item should be abandoned as junk and when reclaimed, and some rather unexpected facts were developed, such as the undesirability of making fence posts out of discarded telephone and telegraph poles, repairing rubber boots, or wrecking buildings, which were often found to cost more than their final value.

Locomotive Crane Reclaims Water Main

About 800 feet of old cast iron water main buried in very hard clay about 6 feet below the surface of a waterbound macadam road has been reclaimed by O. J. Winsor of Elyria, Ohio, who estimated that he saved $104 by making an excavation with a locomotive crane and clamshell buckets instead of doing the work by hand, which would have required a gang of about 16 men.

The crane mounted on steel traction wheels was towed two miles to the job in 45 minutes by a 3-ton truck. It was equipped with a ½-yard excavating bucket, especially rigged to secure maximum closing power, and operated to make the trench 3 feet wide and from 6 to 7 feet deep in about 14 working hours for which two days time was allowed at $20.00 per day. The digging was a little slower at the bottom of the trench on account of the narrow clearance of the buckets and because of the care necessary in order to avoid injuring the pipe some of which was broken. The only shovel work necessary was to dig around the joints.

PUBLIC WORKS

Published Weekly
at 243 W. 39th St., New York, N. Y.

S. W. HUME, President J. T. MORRIS, Treasurer

Subscription Rates
United States and Possessions, Mexico and Cuba $3.00 year
All other countries ....$4.00 year
Change of Address
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Western office: Monadnock Block, Chicago
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Height of Curbs

How high should a city curb be? Is there objection to reducing the height by laying a wearing surface of sheet asphalt or other material on an old brick or other pavement, by flattening the cross-section originally designed for a macadam street, or for any other reason? This question is confronting city engineers more and more as city streets are being repaved.

The chief purposes of a curb are to keep roadway traffic and the gutter flow of storm water off the sidewalks, to give support to the sidewalk pavement or parking at a level higher than the roadway, and to add to the attractive appearance of the street. At street intersections the curb should not be higher than it is convenient to step up or down, unless there is a bridge across the gutter or unless steps are provided, which latter is generally to be avoided if possible.

Six inches has for years been about the standard. Steel-tired wheels could not mount it, it was seldom that the gutter flow exceeded this depth, and it was a convenient height for pedestians.

But with the general use of pneumatic tires, six inches no longer serves as any obstruction to vehicles. A six-inch curb shows them the limits of the roadway, which a two-inch curb would do about as well, but it would take a 12-inch curb or more to prevent their mounting it. And a 12-inch curb would be too high for pedestians, and would generally mean excessive cost for excavating the roadway and for the curb.

As to supporting the sidewalk, the shallower the curb the better it can perform this service. A curb three inches high has been used in some cities where a new surface has been put on an old pavement, the only change made being the introducing of more storm-water inlets on flat grades, to prevent flooding the sidewalks. This matter of gutter flow seems to be the only serious objection to the low curb, and with a sufficient number of inlets this largely disappears.

The low curb at first looks peculiar, but if the curb is in good grade and alignment we believe the appearance is equally as good, once one is accustomed to it. And it is more convenient for pedestrians and especially so for those wheeling baby carriages.

It would appear therefore that, provided gutter flow is adequately cared for, there is no good reason why a curb should not be as low as three inches, and often there are good reasons why it should be.

Salvaging and Reclamation on Construction Work

The importance of the systematic disposal of equipment that has been used on important construction work is forcibly illustrated by the description in this issue of the method of disposal of a vast amount of miscellaneous plant and supplies during the progress of and after the termination of a 5-year period of heavy construction in the flood-prevention work of the Miami Conservancy District, Ohio.

This work, which has cost more than twenty-five million dollars, consisted largely in the building of five great earth dams and their concrete controlling works, the relocation of railroads and highways, and the improvement of the river channel, which involved the purchase of a great amount of heavy construction plant, large quantities of miscellaneous supplies and equipment and the establishment of camps, commissaries, and stores for many employees. An unusual proportion of the mechanical apparatus, including big dragline excavators, concrete mixers, large pumps and other important items of power driven apparatus, were operated by electricity, making a large percentage of high-class plant with some delicate features.

The work is now nearing completion and much of this plant has already been released and is being put on the market by the well established purchasing division. The prices are fixed by an appraisal board and reviewed by the chief engineer, who approves or modifies the prices fixed after careful consideration by the purchasing division, salvaging division and master mechanic.

Effective newspaper advertising and publicity cooperation with reading articles has been effected, sales lists have been mailed to prospective buyers and many personal visits have been made by district representatives to possible customers. An excellent demand for some articles has been created, and where the prices have greatly increased through war conditions since the plant was purchased, some of it has found a ready sale at prices above what was paid for it when new. Very little of the large equipment has yet been sold, but much of it will be offered immediately after Christmas. Small articles are sold locally and the remainder are stored in the central warehouse at Dayton. Camp buildings, tracts of land and an entire waterworks system have been sold in place.

An important feature has been the methodical reclamation of damaged equipment during the progress of the work. This was found to be so advantageous that a special organization was put in charge of the junk piles and trained employees have selected various classes of damaged equipment, such as gasoline pumps, jacks, dump cars, steam gages, valves and many small articles and have had them repaired or had defective parts replaced by disassembling similar items in which these parts were not damaged. In this way about $35,000 worth of jnk was reclaimed at a cost of about $3,000 and reissued at a valuation of $60,000, showing a clear profit of $22,000 besides the value as an object lesson in economy and conservation.

The same organization did very effective work in supervising the local accumulations of spare parts and reducing them to a minimum, justified by resulting promptness of obtaining supplies from one central warehouse, thus greatly reducing the number of duplicates carried and providing a clearing house effective for all parts of the widely distributed operations. A carefully perfected and well maintained policy of this sort on any construction work of importance is likely to have a large direct money value and a possibly larger value for promoting efficiency, avoiding delay and encouraging economy and carefullness.

Advertising Work Brings Low Bids

In a letter just received, a paving engineer of wide experience extending over twenty-five years or more makes the following interesting statement:

> A study of the prices for paving is rather interesting at the present time as it brings out very markedly what effect actual competition is playing in the bids. Where there is no competition a city is liable to obtain abnormally high bids, especially where local contractors are the only ones bidding. For instance, the city of Columbia, S. C., asked for bids on sheet asphalt paving and a price of about $1.80 per square yard for binder and wearing surface was submitted. In Durham, N. C., the lowest bid was approximately $4.19 per square yard for the complete pavement—6 inches of concrete, and binder and wearing surface of the same thickness as that asked for in Columbia. In Columbia there was good competition, while in Durham there was none at all. The prices quoted above are only from memory and are therefore approximate, but they go to illustrate the great difference that may be noted in comparing prices of work for different cities.

Which would seem to indicate that "it pays to advertise" and that the insignificant amount spent in giving wide publicity to a letting may bring a hundred or a thousand fold return in lower cost of the work.

Federal Aid Road Work for 1922

During the month of September the Bureau of Public Roads approved projects for federal aid in a considerable number of states, and the amounts of Federal aid so apportioned are therefore available for work during the year 1922.

The projects approved, and for which bids have not yet been asked, so far as we can learn, are listed below, giving for each state the length in miles of each type of road and the estimated cost:

Alabama: 14.670 mi. gravel, $148,272.85; 4.664 concrete, sheet asphalt, or bituminous concrete, $168,608.

Arkansas: 19.820 gravel, $83,723.05.

Colorado: 4.318 concrete, $169,996.97; steel truss bridge, $27,500.

Idaho: 14.940 bituminous concrete, $25,931.18.

Indiana: 25.653 brick, bituminous, or concrete, $1,002,485; 0.912 brick, concrete, or bituminous concrete, $61,351.84.

Kansas: 19.580 earth, $161,188.50; 716 bituminous filled brick or bituminous concrete, $38,412; 2.680 concrete, $183,163.42.

Kentucky: 2.390 gravel and Kentucky rock asphalt, $41,321.50; 12.000 gravel, $226,820; 9.000 earth, $135,300.

Maryland: 4.940 concrete, $173,488.98; 6.130 gravel $127,579.21.

Massachusetts: 2.550 bituminous macadam, $133,650.

Michigan: 6.382 concrete or bituminous concrete, $253,056.65.

Minnesota: earth, $30,095.36; 74.070 gravel, $1,271,200.10.

Mississippi: 8.460 gravel, $126,593.50.

Montana: 11.030 gravel, $147,688.75.

Nebraska: 35.200 sand-clay, $43,993.92; 12.000 earth, $43,340.

New Hampshire: 4.530 gravel, $50,472.76.

New Mexico: 14,800 gravel, $68,657.60; 17,500 gravel or crushed rock, $98,971.40.

New York: 7,930 bituminous macadam, $188,500.

North Dakota: 15,000 earth, $47,300.

Ohio: 4.971 concrete, $190,000; concrete bridge, $106,000; .904 brick, $60,000; 2.719 Kentucky rock asphalt, $107,000.

Oregon: 3.750 concrete, $119,766.90.

South Carolina: 38.922 sand-clay, $172,946.52; bridge, $12,056.05; 32.965 top soil, $88,953.90.

Souteh Dakota: 29,320 gravel, $183,253.40; 9.470 earth, $31,262.

Texas: 12,906 gravel, $256,590.87; 22.407, gravel bituminous top, $500,231.58; 14.200 earth, $69,999.99; 17.250 gravel and macadam, $103,500.79.

Utah: 33.020 earth and gravel, $169,525.24; 13.271 concrete, $199,646.24.

Virginia: 2.100 bituminous macadam, $48,033.08.

Wisconsin: 5.850 gravel, $53,441.83.

Demand for Development Construction Relieves Unemployment

Reports from the executive offices of the Associated General Contractors are that conclusions to be drawn from their recent official inspection trip to the Pacific Coast are that "there was no need for public appropriations for useless and monumental public construction, so long as the demand for hydro-electric development, adequate terminal facilities, irrigation, and housing remained unsupplied. It was found that the war had brought this section of the country from an agricultural stage to the beginning of an industrial development which is seeking facilities and opportunities for adequate expression. To supply these will not only more than take care of the present unemployment problem, but also mean an era of development exceeding that following the Civil War."

Paving Contractors' Ingenuities

In impounding water on concrete highways for curing the concrete, the surface is apt to be scoured by the water as it leaves the hose. To prevent this a device has been used advantageously according to the *Concrete Highway Magazine;* a gunny sack has been wired to the end of a pressure hose and the water discharged through it on soft concrete where it is impounded for curing purposes. The bag is inflated by the water pressure until it forms substantially an hydraulic cushion through which the water is sprayed and is diffused over the concrete without scouring it.

Another ingenuity described in the same periodical is the use of an old 12-inch band saw blade in the construction of expansion joints for concrete pavement. The straight edge of the blade was stiffened by being bolted to a long 2 x 4-inch strip of wood projecting beyond the ends of the steel to rest on and be secured to the wooden side forms. The permanent elastic joints were placed against the vertical face of the saw blade and temporarily held by adjustable steel fingers until the apparatus was removed.

An Early Start on Road Work

With a desire to get as early a start as possible in road building next spring, county commissioners have for several weeks past been visiting the state highway department at Columbus, Ohio, to take up their next year's plans with the director of the Department. By the end of November, commissioners from thirty counties had had interviews with Director Herrick for this purpose.

Competition for Water in New Jersey

It has already been reported in these columns that Bayonne, N. J., has petitioned the New Jersey State Conservation Commission for permission to develop the Ramapo watershed in order to obtain a water supply. In addition to Bayonne, Bloomfield and Pompton Lakes, N. J., have also applied for similar permission. Bloomfield's application will come up for a hearing in January, and unless other applications are presented before that time, it is believed that the board will reach a decision on all three applications sometime during the month.

Pompton Lakes now uses between 150,000 and 300,000 gallons of water a day, which is obtained from wells, which supply is said by the state board of health to be occasionally of doubtful safety. In addition to the doubtful quality of the water, the quantity is inadequate during dry seasons. The borough asks permission to obtain from the Ramapo river a maximum of 600,000 gallons a day, which amount the rapid growth of the borough would soon make necessary.

A great many of the communities in northern New Jersey are more or less agitated over the matter of water supply and many of them, as in the case of the Ramapo supply just cited, are contending with each other. An effort is being made to unite these municipalities so that a plan may be worked out that will be as far as possible satisfactory to all concerned. It was the purpose of the creaton of the conservation board that it should control the water supplies of the state with just this idea in view. However, the agency provided for actually carrying out the decisions of the board by the development of the available water supplies has given rise to a great deal of dissatisfaction. Newark, as was stated in these columns a few weeks ago, is objecting to having a state board, the North Jersey District Water Supply Commission, build the Wanaque dam while Newark furnishes all the money for the expenses of the board as well as for the construction of the dam but has practically nothing to say about the carrying on of the work. Should Bayonne or one of the other communities be permitted to develope the Ramapo watershed, this would probably need to be done under the control of the same board and the same objections might be found as in the case of Newark.

Because of these objections to the existing agencies, plans were made, at a meeting in Newark on December 8th of representatives from a number of New Jersey municipalities, for effecting an organization of the communities in Hudson, Essex, Passaic and Bergen counties for developing water supplies for these several communities, and incidentally for bringing about a dissolution of the present commissions and the adoption of some new plan for meeting their needs. City Commissioner Thomas L. Raymond of Newark, who called the conference, stated that there was too little accurate information on the available conditions as to water supply in northern New Jersey, and especially too much working at cross purposes and disputes among the municipalities, with litigations which were costly to the taxpayers without producing any results. He stated that writs of certiorari could tie up more public work and do more mischief generally than any other agency he knows of. As the result of this conference a committee on organization has been appointed and other committees to report on other matters preliminary to a formal perfecting of the proposed organization.

They Come High, But We Must Have 'Em

If Texaco Tips don't want its articles appropriated it has no right to publish such delicious ones as the following. Copyright or no copyright, here it is:

When earth's last project is finished,
And the concrete is ready to bust,
When the chief engineer has departed,
And the last engineer gone dust,
We shall rest, we surely will need it,
For our brain will be covered with rust,
From the worry the engineer caused us,
In making us do it or bust.

Not an engineer then will be happy,
They will all go up in the air,
When they find how the wise old contractor
Put it over them everywhere.
And got by with a ten to one mixture
When they thought a six to one there,
And got a fat estimate furnished
When the engineer swore all was done fair.

When earth's last project is finished,
And all good contractors are there,
Where estimates never are furnished,
And dictations are few and rare;
Where the golden paved streets were finished,
By contractors honest and fair,
Without a transit or level,
For I am sure no engineers are there.

But until the end of creation,
Contractors mustt always submit
To the engineer's cry and dictation,
And make him think that he is it.
And give him the morning's paper,
And talk of the ladies fair,
And give him a drink of moonshine
While shooting the concrete there.

But until earth's last project is finished,
We must call on the engineer,
For the technical end of our business,
We contractors who figure so queer.
For without his learning and figures,
His transit, and level, and grade,
We would loaf around forever,
With never an estimate paid.

So we ask you all to praise us,
For getting by you we blush with shame,
We are all skinning to get the money,
None of us ever work for fame.
We take no joy in working,
But we sit in a Morris chair,
And we run things as we wish to,
In spite of you being there.

With kindest regards to Texaco Tips and Wild Bill Howren, I am,
Honestly,
W. H. CRAMER,
407 Sumpter Building, Dallas, Texas.

Protecting Jersey City's Water

Nearly twenty years ago Jersey City was a party to a suit in connection with its water supply that was a most important one to water works men in that it did much towards establishing in favor the use of hypochlorite for sterilizing public work supplies. At that time the city asked the courts to require the East Jersey Water Co. to provide an intercepting sewer to remove from the Boonton reservoir sewage that was entering it from small communities on the tributary streams. It was claimed in defense that, the amount of sewage entering being very small, the use of chlorine as a disinfectant would render the water perfectly safe, and the courts accepted the opinions of the engineers in favor of this stand. Since that time chlorination has been used on the supply as it comes from the Boonton reservoir.

However, the population on the westershed of the reservoir has been increasing and the Jersey City water department has been keeping careful watch of the several tributary streams and sometime ago was convinced that the point of pollution had been reached where chlorination alone was not a sufficient protection. Accordingly it made plans for constructing an intercepting sewer in the Rockaway river valley, the sewage so collectedt to be treated and the effluent discharged into the Rockaway river below the Boonton dam. As the Rockaway river discharges into the Passaic river, from which the East Jersey Water Co. obtains the supply for Paterson, Montclair and several other municipalities, that company endeavored to secure an injunction from the courts restraining Jersey City from building such intercepting sewer and treatment plant. Experts testified for both sides and early in December Vice-Chancelor Griffin refused to grant such injunction, leaving the East Jersey Water Co. the privilege, however, of again applying for an injunction if, after the disposal works had been built, it appears that the effluent contaminates the river from which it draws its supply.

This decision is similar to the one handed down a few months ago by the Federal Court by which the Passaic Valley Sewerage Commission was permitted to discharge clarified sewage into New York harbor, the privilege being granted New York, however, of again appealing for an injunction after the discharge of such sewage had been in operation, if it then appeared that a nuisance was being created. This would seem to indicate, what is probably the case, that the judges were not satisfied by the evidence of the witnesses that a nuisance either would or would not be created. As a matter of fact, there is little question in the minds of sanitary engineers that a plant can be designed and operated that would produce an effluent that would not create a nuisance under any specified condition, or that on the other hand the same plant could be so operated (and would be unless care and intelligence be empolyed) as to create a most decided nuisance. Such being the case it would seem reasonable for the courts, in every case of this kind, to refrain from enjoining the construction of such plants, but to hold themselves open to complaints at any time that a certain plant is creating a nuisance, and to decide thereupon, not that the plant should be discontinued altogether but that it should be operated so as to avoid the objectionable results.

Types of Federal Aid Roads

A summary has been given out by the Bureau of Public Roads showing the distribution of federal aid among the various classes of roads constructed by the different states with the aid of federal funds. Up to date these funds have totaled more than $211,000,000 and have been applied towards the construction of 2,135 miles of roads, the total cost of which has been more than $49,000,000 and has averaged $17,630 a mile.

Nearly 36% of the federal aid funds was for concrete roads, about 23 per cent for gravel roads, 12 per cent for grading and drainage, 9 per cent for bituminous macadam, 4½ per cent for bituminous concrete, 3¼ per cent, for brick and about 5 per cent for sand-clay.

The mileage and total cost of each of these several classes were as follows: 4,654.6 miles of concrete cost about $160,000,000. 10,043.5 miles of gravel road cost $104,614,067. 6,864 miles of grading and drainage cost $55,704,254. 1,323.2 miles of bituminous macadam cost $41,412,557. 772.5 miles of bituminous concrete cost $23,445,375. 444.6 miles of brick road cost something over $14,000,000. 2,695.5 miles of sand-lay road cost $22,226,363.

Recent Legal Decisions

PLANT FOR SPREADING GARBAGE AS FERTILIZER HELD NOT A GARBAGE REDUCTION PLANT

In a proceeding in equity by the board of health of Baltimore County to restrain the city of Baltimore and one under contract with it from spreading garbage in the county on the ground that it constituted a nuisance affecting the public health, the Maryland Court of Appeals holds, Mayor, etc., of Baltimore v. Coghlan, 115 Atl. 43, that wharves used as a dumping place for city garbage destined to be spread over surrounding land as fertilizer did not constitute a "garbage reduction plant" within the meaning of Acts 1908, c. 205, prohibiting the erection of any garbage reduction plant within nine miles from the Lazarette Lighthouse on the Patapsco river.

The court says that the proper rule, as approved in its prior decisions, is "to leave injured persons their remedies for damages when that affords ample relief, and not tie up municipalities by injunctions when that can reasonably be avoided. In this case we have plaintiffs who represent the health of the public; and one of their statutory duties is to prevent nuisances, when that can be done. In order to justify the continuance of an injunction against the city in this case, there must be clear and positive evidence calling for such interposition of a court of equity, and the danger to the health of the people of the county must not be merely speculative, but established with reasonable certainty; but, as the case stands now, we feel that the defendants should be required to answer." For this reason decree overruling demurrer to the bill was affirmed and the cause remanded with directions to allow the defendants to file an answer.

COST OF PAVING LATERAL STREET HELD NOT TO BE ASSESSED ENTIRELY TO CORNER LOT

The Idaho Supreme Court holds, Amsbary v. City of Twin Falls, 200 Pac. 723, that, under C. S. § 4000, 4005, the cost of paving a lateral street should not be assessed entirely to the corner lot, but should be assessed to all the lots to the centre of the block, in proportion to the benefits derived. This construction is borne out by the fact that both sections provide that the assessment must be in proportion to benefits derived, it being clear that the inside lots do derive some benefit. The same court, in construing a statute containing similar language, held that the benefits are the most important consideration. Blackwell v. Village of Coeur D'Alene, 13 Idaho, 357, 90 Pac. 353.

SOUTH DAKOTA CITIES MAY MAKE VALID CONTRACTS FIXING RATES WITH UTILITY COMPANIES

The federal district court for the Western District of South Dakota holds, Water, Light & Power Co. v. City of Hot Springs, 274 Fed. 827, that the South Dakota statutes authorizing municipal corporations to provide for lighting streets and public grounds, and to regulate the openings for gas and water pipes and the erection of electric light poles, and providing that gas and electric companies, with consent of the city council, may lay down pipes and string wires, subject to regulation by ordinance, confer no power on a city to regulate or change rates for electricity, and a city, in granting an electric company a franchise, may, by contract with the company, fix maximum rates for a stated term. Such a contract will be valid and binding during the term, regardless of the fact that the rates so fixed are or may become confiscatory. An ordinance granting a franchise including such a contract fixing rates for the term of the francise is not in violation of article 6, § 12 of the South Dakota Constitution, providing that "no law making any irrevocable grant of privileges, franchises, or immunity shall be passed."

RECOVERY BY CONTRACTOR OF COST OF SUBSTITUTED SURETY BONDS

The Maryland Court of Appeals holds, Barber Asphalt Co. v. Poe, 115 Atl. 24, that a street paving contractor which, on its surety's going into the hands of a receiver, though not declared insolvent, had, at the city's request, executed new surety bonds in another company, could not recover from the receivers the total unearned premiums on the old bonds from the date of the receivership, in the absence of evidence of any default thereon or of the suretys' inability to pay in case of such default. The contractor could, however, recover the amount paid for the new bonds, these having been substituted with the consent of the court and receivers with the understanding that by their execution the company and its receivers were released from further liability.

SUBSTITUTION OF OIL FOR PITCH IN SURFACING A PAVEMENT HELD A MERE IRREGULARITY NOT VOIDING AN ASSESSMENT

A city council, by proper proceedings under the Iowa statutes, obtained jurisdiction to improve a street by surfacing it with pitch. In lieu thereof, and for the same general purpose, they substituted oil for pitch as to the greater part of the improvement. In an action to enjoin the collection of special assessments levied to pay for the work, the Iowa Supreme Court holds, Manning v. City of Ames, 184 N. W. 347, that this was such an error or irregularity in the proceedings for which jurisdiction had attached that proper adjustment because thereof by reduction or cancellation of an assessment would have been proper for the consideration of the city council, but it did not constitute such a change of the subject matter, of which the council had jurisdiction, as to render the proceedings wholly void. It therefore followed that the plaintiffs' remedy was by the statutory method, and not by injunction, and, having failed to appear before the city council and object to the assessment under the express provisions of section 824 of the Iowa Code, the right to object was barred.

NEWS OF THE SOCIETIES

CALENDAR

Dec. 20—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamher of Commerce. Secretary, Prof. W. H. Kavanaugh Un. of Penn.

Dec. 22-23—KANSAS ENGINEERING SOCIETY. Annual meeting. Hutchinson, Kan. Secretary, J. M. Averill, Topeka.

Dec. 28—BOSTON SOCIETY OF CIVIL ENGINEERS. Special meeting. Tremont Temple, Boston. Secretary, Richard K. Hale.

Dec. 27-30—AMERICAN ECONOMIC ASSOCIATION. Pittsburgh, Pa.

Dec. 28-20 — AMERICAN ASSOCIA-FOR LABOR LEGISLATION. Fifteenth Annual Meeting Pittsburg. Frederick MacKenzie, Director of Publicity, 131 E 23rd St., New York.

Dec., 27-31 — AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, SMITHSONIAN INSTITUTE, Washington, D. C. Toronto, Canada.

Jan. 4-14 — CLEVELAND, OHIO, BUILDING EXPOSITION. Municipal auditorium, Cleveland, Ohio.

Jan. 5-6 — AMERICAN ENGINEERING COUNCIL, FEDERATED AMERICAN ENGINEERING SOCIETIES. Annual meeting, Washington, D. C.

Jan. 6—DETROIT ENGINEERING SOCIETY. Secretary, O. H. Dawson.

Jan. 9 — MEMPHIS ENGINEERS' CLUB. Memphis, Tenn. Secretary, A. S. Fry, Memphis.

Jan. 10—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary, N. L. Nussbaumer, 80 W. Genesee St., Buffalo.

Jan. 12 — ENGINEERS' CLUB OF DES MOINES. Des Moines, Ia.

Jan. 12-14—HIGHWAY ENGINEERS' ASSOCIATION. Baltimore Hotel, Kansas City, Mo. Secretary, C. W. Brown, State Hgwy. Dept., Jefferson City, Mo.

Jan. 13 — ENGINEERS' CLUB OF SEATTLE. Seattle, Wash. Secretary, Lyman T. Banks, 916 L. C. Smith Bldg., Seattle.

Jan. 14—LOUISIANA ENGINEERING SOCIETY. New Orleans La.

Jan. 17-10 — IOWA ENGINEERING SOCIETY. 34th annual meeting. Sioux City. Secretary—Lloyd A. Canfield, Des Moines, Ia.

Jan. 17-19—ASSOCIATED GENERAL CONTRACTORS. 3rd annual meeting. Hotel Winton, Cleveland Ohio.

Jan. 17-19—ASSOCIATED BUILDING CONTRACTORS OF ILLINOIS. Chicago, Ill.

Jan. 17-20—ASSOCIATION OF CANADIAN BUILDING AND CONSTRUCTION INDUSTRIES. 4th annual conference. Royal Connaught Hotel, Hamilton.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Jan. 18-19—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. New York City.

Jan. 18—ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS. Annual meeting. Secretary, Miss C. B. Adams, 3817 Olive St., St. Louis.

Jan. 18—SIOUX CITY A. A. E. Joint meeting with the Iowa Engineering Society convention. Sioux City, Ia.

Jan. 20—BRIDGE BUILDERS' AND STRUCTURAL SOCIETY. New York City.

Jan. 24-26—ILLINOIS SOCIETY OF ENGINEERING. 37th annual meeting. Decatur, Ill.

Jan. 27 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Bldg., New York City. Secretary—G. I. Rhodes, 115 Broadway, New York City.

Jan. 27-28 — WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION. Kansas City, Mo.

Jan. 27-28 ARKANSAS CHAPTER, A. A. E. Little oRck, Ark.

Jan. 30—SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention Cleveland. Secretary Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING, 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' building, New York City.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Auditorium, Cleveland, Ohio.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

IOWA ENGINEERING SOCIETY

The 24th annual meeting of the Iowa Engineering Society will be held at Sioux City, Ia., on January 17-20th inclusive. The membership of the society has been greatly increased during the past year, and the activities of the organization, under the leadership of President J. H. Dunlap, are so interesting to the engineers of the state, that a much larger number than usual will be expected at the annual gathering.

BOSTON SOCIETY OF CIVIL ENGINEERS

A meeting of the Boston Society of Civil Engineers was held at Chipman Hall, Tremont, on December 21st, at which Arthur W. Dean, chief engineer, Division of Highways of the Public Works, Department of Massachusetts, spoke on "Highway Construction in Massachusetts." Following this address was a discussion of the subject opened by John R. Rablin of the Metropolitan Park Diviion.

DETROIT ENGINEERING SOCIETY

The Detroit Engineering Society, at its meeting on January 6th, will be addressed by Albert W. Dilling, chief engineer of the Sanitary District of Chicago, on his work with the Metropolitan District.

ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS

The Associated Engineering Societies of St. Louis, at its annual meeting on January 18th, will be addressed by Dean Mortimer E. Cooley, president of the Federated American Engineering Societies.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

L. W. Wallace, executive secretary of the Federated American Engineering Societies will address the engineering secteion of the American Association for the Advancement of Science at its annual meeting on December 27-31 in Toronto. Other speakers at this meeting will be J. B. Tyrell, vice-president of the section and a member of the American Institute of Mining and Metallurgical Engineers, and W. S. Murray, chief engineer of the Super Power Survey.

BROOKLYN ENGINEERS' CLUB

At the regular meeting held in the house, December 8th, at 8.30 P. M. Paper No. 178, entitled: "The New Floating Dry Docks at the Plants of the Sun Shipbuilding Company and the Federal Shipbuilding Company, Built in Record Time," were presented by Mr. David W. Barnes, Manager for William T. Donnelly, Consulting Engineer, N. Y. City.

The paper was illustrated by lantern slides.

THE AMERICAN ROAD BUILDING ASSOCIATION

The new directors, elected November 15th, have chosen an executive committee composed of H. L. Bowlby, Washington, D. C., president; E. L. Powers, New York, secretary, and James H. MacDonald, New Haven, Conn., treasurer, of the association; H. E. Breed, New York, and R. A. Meeker, Trenton, N. J. This committee is assisting Secretary Powers in organizing the Congress and Show.

ASSOCIATED PENNSYLVANIA HIGHWAY CONTRACTORS

In connection with the second annual meeting of the Associated Pennsylvania Highway Contractors, which was held on December 16th in the Penn-Harris Hotel, Harrisburgh, Pa., a conference of the Highway Construction Industry of Pennsylvania was also held. The program included a session in the morning on "Side of Road Construction" and one in the afternoon, the subjects of which were "Equipment Manufacturers' Side of Road Construction," "Mechanical Handling of Road Materials" and "Pennsylvania State Highway's Side of Road Construction." Following these sessions a subscription dinner was held at 7 o'clock.

LEAGUE OF THE NORTHWEST

A meeting of the League of the Northwest was held at Riverside, Cal., on December 8th and 9th, the purpose of which was to gather the opinions of the states of the Southwest in regard to the mode of procedure for the development of the entire Colorado river and to present this information to the Secretary of the Interior. A program of over 25 addresses was presented, each state in the basin being represented by one or more speakers, on the proposed development for irrigation, power and flood protection of the Colorado river, but controversies between the adherents of public and private waterpower operation prevented any definite results.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

QUADRUPLEX ROAD BUILDERS PUMP

Bulletin No. 107, of the Barnes Manufacturing Co., describes the large Quadruplex Road Builders pumping outfit which is claimed to be the most powerful portable pumping unit ever developed for water supply on road construction. The initial one of these units installed on road job supplied all the water necessary, for the 21E paving mixer and for curing the concrete, through 21,000 feet of 2-inch pipe and against a head of 310 feet. Under these conditions the pump operated at 490 pounds, often 24 hours per day, as during the extremely hot days of last summer it was necessary to cure the concrete at night as well as during the day.

The pump has been especially designed for the continuous heavy duty service required of a pumping unit on road construction. The 300 and 500-pound guaranteed working pressures of the two most popular sizes insure the displacement capacities of 40 and 60 G.P.M. respectively, being delivered to the paving mixers regardless of the conditions of elevation and distance. The pump is of the outside packed type with four plungers set at 90 degrees with respect to each other so that two are always on the suction and two on the pressure stroke, giving a steady flow with minimum pulsation.

The four cylinder pump is driven by a four cylinder engine; the La Roi in the 40-gallon-300 pound size and the Hercules in the 60-gallon-500 pound size. Each engine is mounted in three point suspension and the truck frame is similarly mounted. This mounting, in connection with the riveted gusset plate construction of the truck frame insures permanent alignment of the pump and engine.

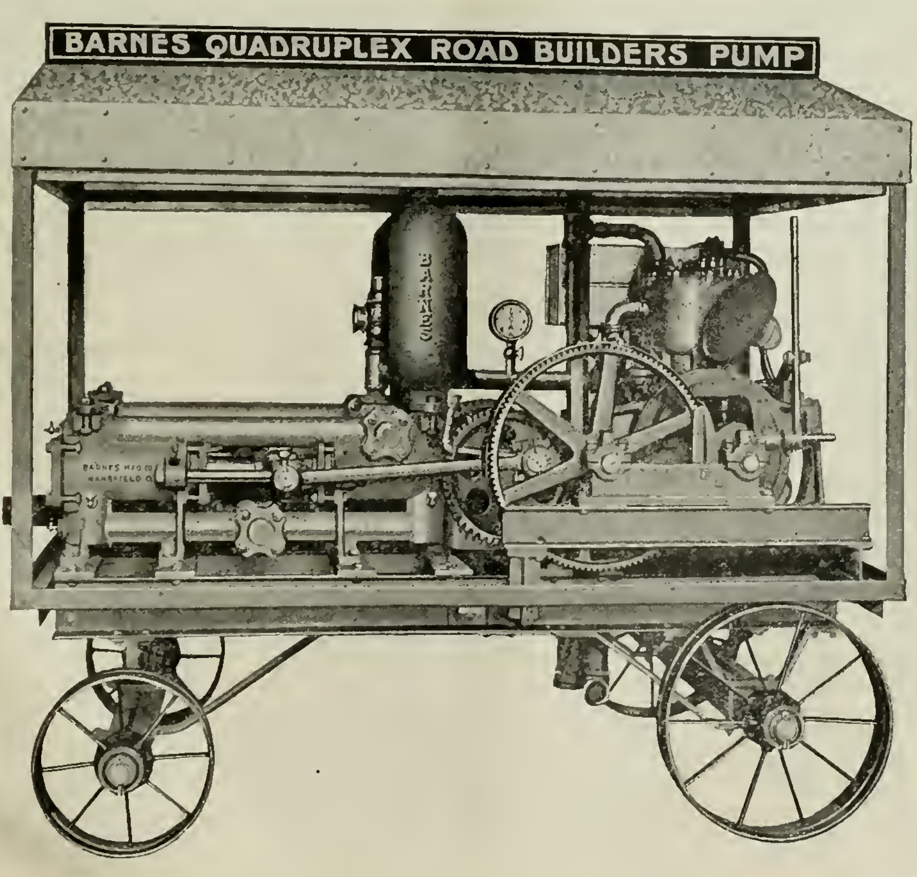
In concrete road construction, during the summer months, extremely hot weather often requires curing of the concrete at night, as well as during the day, necessitating 24-hours service of the pumping outfit. If the conditions of elevation and distance are severe, resulting in a high pressure on the pump, a dual unit consisting of two separate pumping plants mounted on one truck, is recommended. The pipe connections permit of operating one pump while the other is idle for adjustments.

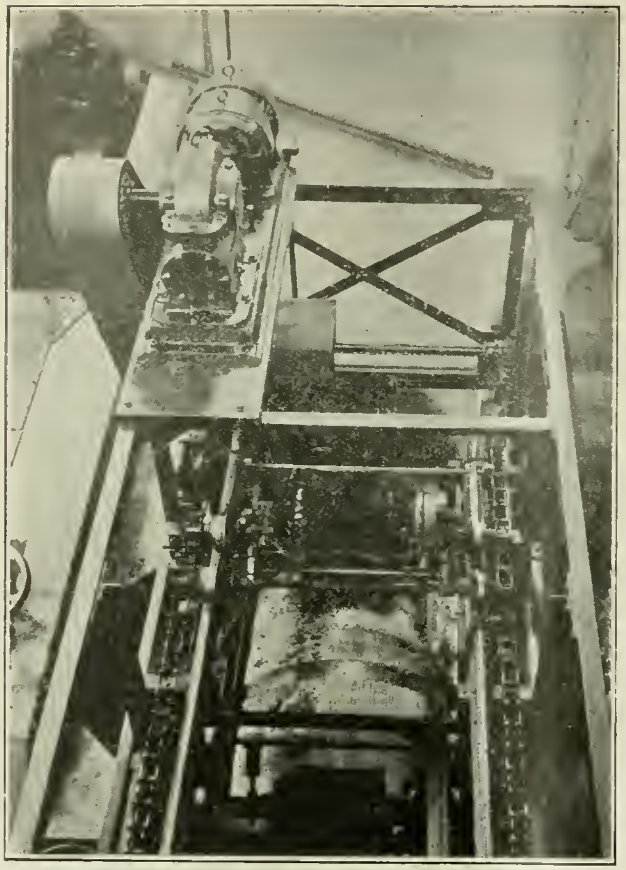
The importance of thoroughly watering the concrete in curing is now fully recognized and the contracts now specify that the concrete be wholly covered by impounding the water or by applying it from sprinkling nozzles placed at frequent intervals. Either system requires a large volume of water so that a larger pumping outfit is now required than formerly. In addition to the 40 and 60-gallon displacement units the Quadruplex is also made in a 100-gallon-300 pounds pressure size which will furnish an abundant water supply to the largest paving mixer and at the same time for abnormal sprinkling conditions.

The pump and engine, of the Quadruplex are enclosed in a galvanized sheet steel housing with removable sides thereby providing means for locking up the outfit at night.

NEW LINK-BELT SEWAGE SCREENS

The Link-Belt Company has designed a fine sewage screen, that combines great strength and rigidity with efficiency and reliability of operation. It is a cylinder covered by perforated plates or the Link-Belt Straight Wire Screen, which consists of bronze wires stretched tightly across a bronze frame. The sewage enters on the outside of the cylinder and is discharged at one end from the inside; 90 to 95 percent of the total screening area is submersible; in other words effective. Seal rings sep-





"LINK BELT" SEWAGE SCREEN OF THE PLEASANTVILLE, N. Y., PLANT

arate the clarified from the raw sewage.

The screen is cleaned by revolving brushes, that always travel in line with the openings and never across them. This feature together with the small openings—made possible by the Link-Belt Straight Wire Screen—insure the removal of all but the finest solids in suspension. No parts of the driving machinery are hidden, all parts of the screen can be inspected and cleaned without interrupting the operation.

Two of these machines are now in operation at the sewage treatment plant, Pleasantville, N. J., and are giving an excellent account of themselves.

PERSONALS

Thompson, R. A., has been appointed chief engineer in charge of construction of dams and the irrigation system of the Wichita County Water Improvement District, Wichita Falls, Tex.

Goodwin, R. T., Jr., of Athens, Ga., state highway engineer, was killed on November 8th in an automobile accident.

May, Charles A., has been appointed state engineer of New Mexico.

Cappelen, F. W., city engineer of Minneapolis, Minn., died recently.

Kendrick, Julian, city engineer of Birmingham, Ala., has resigned.

Ross, C. H., of Sioux Falls, has been appointed member of the South Dakota state cement commission.

Talbot, W. F., has resigned as engineer of the Holliston, Mass., Water Company's pumping station, after 21 years of service. He has been succeeded by Mr. Elms.

Vergison, Fred, is acting superintendent of the water board of Johnson City, N. Y., in place of Louis P. Allen, who resigned.

Further election returns show the following mayors elected: Bridgeport, Conn., Frederick Atwater; Cambridge, Mass., Edward W. Quinn, re-elected; Manchester, N. H., George E. Trudell; Burlington, N. J., Thomas S. Mooney; Paterson, N. J., Frank U. Van Noort, re-elected; Amsterdam, N. Y., Theron Akin; Binghamton, N. Y., Thomas A. Wilson, re-elected; Gloversville, N. Y., Frank A. Patten; Hornell, N. Y., Fred. A. Roberts, re-elected; Ithica, N. Y., Louis P. Smith; Johnstown, N. Y., Percy Ripton; Middletown, N. Y., Robert Lawrence; New Rochelle, N. Y., Harry Scott, re-elected; Oswego, N. Y., Prouse Neal; Poughkeepsie, N. Y., George D. Campbell; Rome, N. Y., Dr. William B. Reid; Syracuse, N. Y., John H. Walrath; Troy, N. Y., James W. Fleming, re-elected; Utica, N. Y., Dr. Fred J. Douglas; Marion, Ohio, George Neely; and Pittsburgh, Pa., Ex-Mayor Magee.

INDUSTRIAL NOTES

The firm of Hudson and Myron, with offices at 808-810 Wabash bldg., Pittsburgh, Pa., has been formed for the practice of engineering, by Leo Hudson, who for fifteen years has been in private practice, principally on waterworks sewerage, power plants, valuations and rates, and John P. Myron, who has been connected with the Pittsburgh Filter and Engineering Co. for seventeen years as secretary and engineer.

The Chippewa Pump Co., of Chippewa Falls, Wis., is represented in New York City by H. W. Goodloe, 26 Cortland st. Mr. Goodloe is the New York representative for the Crain Pump & Lumber Co. of Philadelphia, who are agents for the Chippewa pump.

The Combustion Engineering Corporation, New York City, has opened two branch offices, one in Charlotte, N. C. in charge of T. E. Nott, and the other at Seattle, Wash. in charge of Fryer-Barker Co.

The Welborn Corporation, Kansas City, Mo., has been incorporated for $4,000,000, and has acquired the patents, good will, plant and equipment of the Coleman Tractor Co.

Isaac Menline, engineer of design and construction for the Garment Center Capitol Bldg., New York City, has announced the opening of an office at 112 West 42nd Street, N. Y. C., for the practice of engineering.

The George B. Hills Co., engineers, Jacksonville, Fla., has just been established, specializing in drainage, docks and terminals and structural design.

R. F. Helland, for two years city engineer of Waxahacchie, Tex., has formed a partnership with his father, Hans Helland, city engineer of San Antonio, Tex., the firm being Helland & Helland, with office in San Antonio.

THE AMERICAN BUILDING EXPOSITION

The American Building Exposition, originally scheduled to open January 4th in the new Cleveland municipal auditorium, has been postponed until February 22nd; the later date is far more seasonable. Commercial, factory and home construction and equipment will be featured. Approximately $100,000 worth of space will be offered. The show will be put on at actual cost to the exhibitor. Indications point to the sale of every available foot of exhibit space. The staging of the show will be most elaborate. Cleveland lumber interests will combine in an exhibit expected to cost in excess of $25,000. Two brick exhibits will each cost in excess of $15,000. More than a score of others will exceed $5,000 each.

Atlantic Ave., Swampscott, Mass., after application of Standard Macadam Asphalt Binder B, 1½ gals. to the sq. yard by three SOCONY Asphalt Sprayers, full width—27 feet, at one time.

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Standard Paving Flux, Standard Bridge Asphalt and Preserving Oils.

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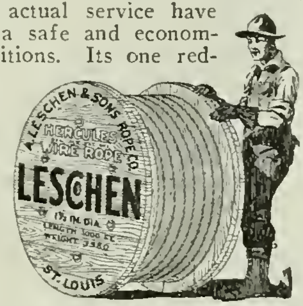
ASPHALT AND ROAD OIL

A Service Tested Wire Rope

The use of HERCULES (Red-Strand) Wire Rope on heavy duty equipment is not an experiment, for its many years of actual service have demonstrated that it is a safe and economical rope for such conditions. Its one red-strand is our guarantee of constant quality.



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Koppel Industrial Car & Equipment Co.
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GENERAL CREOSOTERS—ESTABLISHED 1881
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Street and Traffic Signs

—are the first things a stranger looks for when he arrives in town. First impressions are lasting—welcome visitors to your city with

"ING-RICH"
PORCELAIN ENAMELED IRON
SIGNS

Made of porcelain fused into a sheet steel base, "Ing-Rich" Signs are exceedingly durable as well as attractive. They are guaranteed for ten years, and for a much longer period than that they will retain their brilliancy. Made in any combination of colors.

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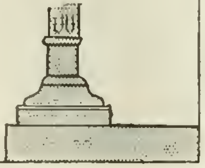

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GRAVEL SCREENING PLANT

This type of screener has proven its efficiency in point of economy, power and saving in labor. Requires a few minutes only for one man to put in or take out of operation.

Continuous bucket loading elevator. This plant can be used for unloading stone, gravel, sand or coal, simply by removing screen.

Indispensable for road contractors, who value time in loading.

We also manufacture brushes, screens, bins, elevators, graders, road rollers, unloading plants, etc.

Catalog showing full line on request.

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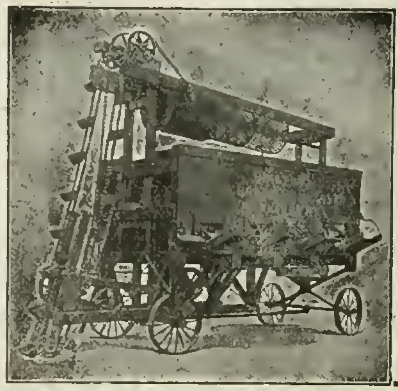

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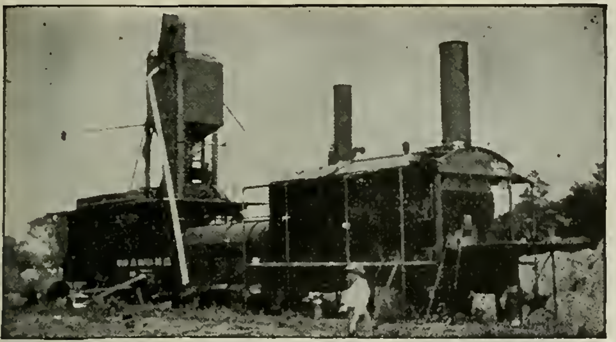

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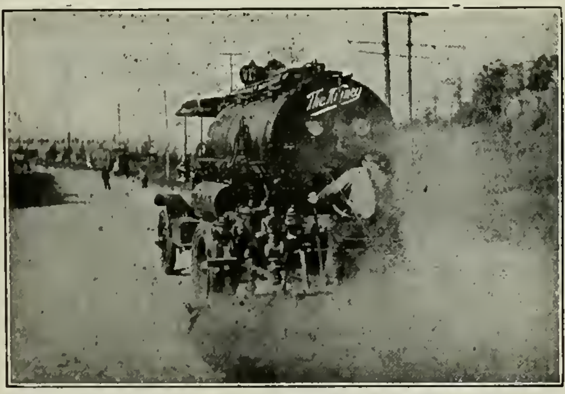

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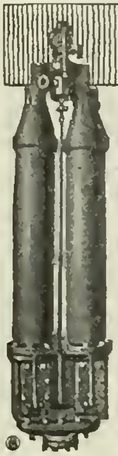

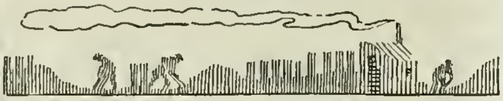

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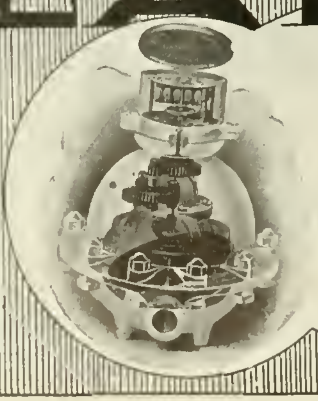

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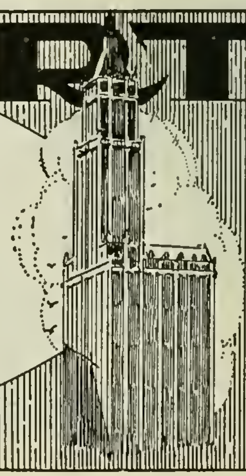

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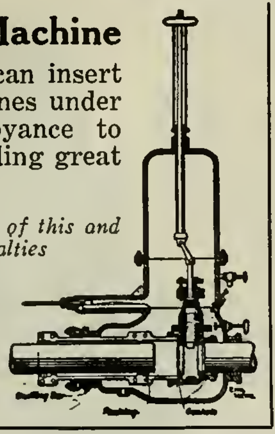

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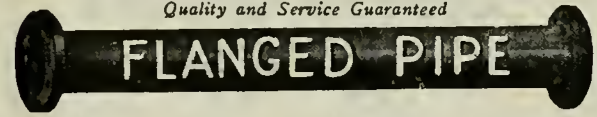

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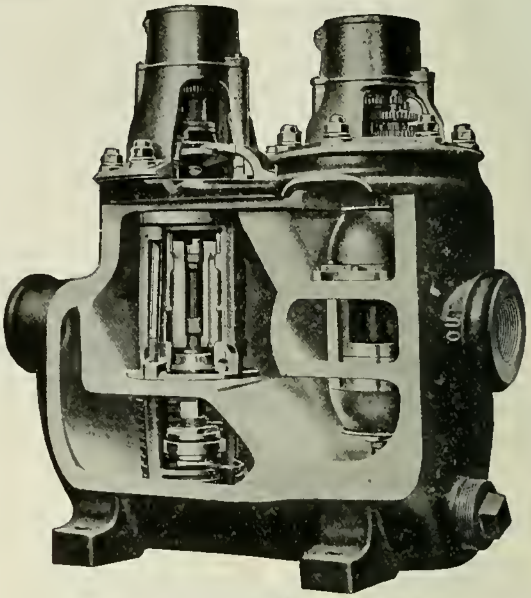

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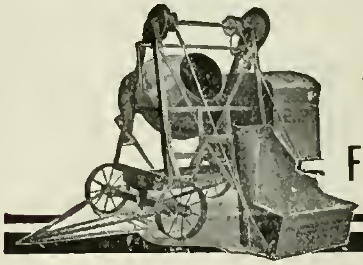

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Vol. 51 DECEMBER 31, 1921 No. 27

Soil and Water Pollution

Area over which pollution may spread and carry germs of intestinal diseases, as indicated by experiments of Rockefeller institute, U. S. Public Health Service and others. Type of soil and depth of water table important factors.

By W. A. Hardenbergh[*]

The question of the area over which dangerous pollution may spread from some focal point, as a pit or open privy, or broken sewer, has long been the subject of discussion and interest. Likewise it is an important matter from the viewpoint of health, and its importance is growing with the increasing density of population. The determination of the danger area is most important in the matter of rural water supplies, and in the selection of types of privies and of sewage treatment plants in all areas where the water supply is from wells, springs, or similar sources.

Two factors must be considered—surface pollution and sub-surface pollution. At first glance the former may seem to lack the importance of the latter; but it is safe to say that a large part of the disease caused by bad wells and springs is due to surface pollution, under which head falls the carriage of pollution by water over the ground surface, and by wind, animals, or other forms of mechanical transportation. Sanitary surroundings and common sense care are the preventives for this sort of pollution.

Sub-surface pollution has the stronger appeal to the imagination. Largely because of the uncertainty and lack of knowledge regarding it, it has often been convenient to attribute to sub-surface contamination many cases of disease which might as easily have come from other sources.

But it must not be concluded that underground travel of pathogenic bacteria is the exception to the rule, and that such sources of disease are unimportant. Experiments have shown that dangerous pollution often travels for considerable distances with underground waters. The possibility of disease spread is always present where there are chances for ground water pollution.

The chance of such disease spread depends to a large extent upon the life of pathogenic bacteria under the conditions they will encounter in septic tanks, underneath the ground surface, in privy pits, etc. Many experiments have been conducted along this line. Typhoid and dysentery bacilli are usually considered to have a life in septic tanks of not more than five days; in soil they will live for much longer periods, even two or three months if the conditions are favorable; in masses of feces, as in privies, the life will rarely exceed two or three weeks.

However, present-day sanitary technique considers as a dangerous indication the presence of B. Coli, and we must therefore hold as dangerous the appearance of B. Coli, irrespective of whether or not the above conditions as to the life of typhoid and dysentery bacilli have been met.

During the past few years the movement toward sanitation has intensified the interest in the possibilities of pollution from privies, septic tanks and leaky sewers, and research has been carried on by several bodies with the purpose of determining the limit of travel of such pollution.

The Public Health Service, through an experimental board headed by Dr. Charles Wardell Stiles, has been making a most complete and far-reaching investigation into this subject. There is no doubt that the results that will be secured from the work of this board will be of the greatest importance, but as yet no definite conclusions are ready for publication, and it is the desire of the Board just now to make no statement. However, it can be said that it has been found that under certain conditions, pollution may travel for considerable distances with ground water; but the distance of travel through soil not impregnated with water is generally limited.

Perhaps one of the most thorough investigations so far made is that recently concluded by Dr. Isreal

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[*] Sanitary engineer for County Board of Health, Jefferson County, Alabama.

J. Kligler of the Rockefeller Institute. The report on the work, which has just been published by the Institute, has been summarized by the Alabama State Board of Health as follows:

The problem was approached from both the experimental and the practical standpoint. In the laboratory repeated tests were made to determine (1) the viability of the typhoid and dysentery bacilli in soil and in excrement under different conditions; (2) their ability to penetrate through columns of soil of different porosity; (3) their viability in septic fluids and effluents; (4) the nature of antagonistic factors in soil and septic material which influence the viability of these microbes. In the field work various types of privies of different ages were examined, particularly with regard to (1) the extent of pollution of soil surrounding these privies; (2) their relation to well pollution; (3) the passage of material through the soil from privies to adjoining wells.

The main conclusion arrived at on the basis of both the experimental and field observation was that in moderately compact clay and sand-clay, or sandy soil, free from cracks, the possibility of sub-soil pollution of the ground water is negligible, provided the ground water level is more than ten feet below the polluted area.

The exeprience of the writer agrees almost exactly with this conclusion, except that he would add the qualifying statement that the ten feet of soil below the polluted area is a safeguard only if there is no excess of water to carry the bacteria rapidly through the soil. In other words, he does not consider a pit privy entirely safe with only 10 feet between its bottom and ground water unless it is so constructed as to prevent the entrance of large quantities of water, which may pass rapidly through the lighter soils, in many cases carrying pollution to the water below.

The summary above mentioned goes on to state that the following facts were established:

1. The typhoid and dysentery bacilli succumb rapidly on exposure to an unnatural environment.

(a) Both typhoid and dysentery bacilli die out in one to five days in septic tanks.

(b) In solid feces the typhoid bacilli may survive for a period of 10 to 15 days, while the dysentery bacilli rarely survive longer than five days. The paratyphoid bacilli are the most resistant members of the group; the Shiga dysentery bacillus is the least resistant.

(c) The survival period of these organisms in soil is greater than in either feces or septic fluids, and varies particularly with the moisture and the reaction of the soil. Temperature does have some effect on the viability, but the two main factors are moisture and reaction. In moist natural soil, the typhoid and dysentery bacilli may be recovered up to 70 days. In the same soil, dry, the bacilli are not recovered after two weeks. In moist acid soil, 90 per cent of the inoculated bacilli die within the first 10 days, but the others may survive as long as 30 days.

(d) The antagonistic action of soil bacteria on typhoid and dysentery bacilli is due largely to the alkaline reaction resulting from their metabolism. Specific inhibitive substances are, however, elaborated by some soil bacteria, notably B. Fluorescens and B. Proteus.

2. The spread of pollution from a focal point is limited in scope.

(a) Typhoid and dysentery bacilli under experimental conditions were not observed to spread laterally to any appreciable extent, although they were carried vertically through a column of two feet of porous soil. In denser soil they failed to penetrate through one foot of soil.

(b) In the field where subsoil was free from pollution either near pit privies or near tile pipes from septic tanks, contamination extended downward to a depth of 3 to 5 feet, and laterally only about two feet.

(c) Heavy rains or constant dripping of water may carry surface pollution to a depth of ten feet.

3. Pollution of wells is usually surface in origin.

(a) There was no correlation between the type or proximity of the privy to the degree of contamination of the adjacent wells. The purity of the well water varied rather with the condition of the well. Driven shallow wells with pumps were, as a rule, free from contamination, while dug wells with pumps or buckets were more or less grossly polluted.

(b) Experiments with fluorescin failed to show subsoil pollution of wells from privies, but proved in some instances at least the possibility of surface contamination.

The summary also refers to a report made by P. A. A. F. Eyken and G. Grijns concerning similar investigations in the tropics. In general the results are very similar. It was found that pollution of the subsoil around pits was very slight. In only one case was it possible to trace pollution as much as 5 meters from the pit. In dry soil, B. Coli were not found at a depth greater than 20 inches; in wet weather the penetration was about three times as great. In the case of high ground water, these authorities seem to think that much pollution is from the soil directly into the ground water and thence to the nearby well, with the privy having no place in the process. This would appear to fall under the head of surface pollution, and illustrates how mechanical (or animal transportation of pollution may be a factor in the spread of disease.

C. L.L Pfau, of the Public Health Service, made some tests in 1919 around various sanitary privy installations in Kentucky. He found that pollution from the effluent pipes of septic closets extended two or three feet on each side of and about ten feet below the point of discharge. Therefore, in case ground water is within ten feet of the point of pollution, contamination may occur. No figures are given for distance of travel of pollutuion with ground water.

The report of the Commission on Additional Water Supply for New York City, made by Burr, Hering and Freeman, records some experiments by Whipple on this same subject, the tests being made at Elmont, L. I. While it is stated that the passage of polluted water, at low velocities, through 25 feet of the finer sands, such as are found in Long Island, will render the water safe to use and that, in most cases, a lesser distance would be considered safe, it is shown that under severe conditions sewage bacteria and B. Coli may pass through soil for a considerable distance.

In these tests a circle of wells was sunk around each of two latrines at a distance of ten feet, with a test well for each latrine 50 feet away. The latrines were six feet deep. The water table was 13½ feet below ground surface. The wells were so placed as to take ground water at 2 feet, 7 feet and 17 feet respectively below the top of the water table.

Samples collected from these wells at intervals showed all the water heavily polluted. The nitrogens were high, esepcially those in the form of free ammonia and nitrates, indicating active decomposition. The bacterial counts also were high, some of the samples containing numbers comparable to those found in sewage. The effect of rainfall on the number of bacteria was great. B. Coli was not present as often as might have been expected. Out of 110 samples of water tested, only 1.8% showed positive B. Coli in 0.10 c.c.; 9.1% with 1 c.c.; and 22.7% with 10 c.c. Five other wells driven at distances of 130 to 220 feet showed indications of active decomposition of organic matter, and two of them gave some positive tests for B. Coli in 10 c.c. samples.

However, when the fact is considered that the bottom of the pit was but 7½ feet above ground water, and the wells but ten feet from the pit, the agreement with the observations of Kligler is considerable.

Dr. C. T. Nesbit (formerly health officer of Wilmington, N. C.) made experiments in New Hanover County, N. C., in 1917, and found pollution of the ground water around effluents from L. R. S. tanks, in some cases up to 20 feet from the effluent pipe, beyond which distance he made no tests. The results in this case were generally such as to indicate that the sand-clay soil in that neighborhood does not fully protect the ground water from fecal pollution, nor prevent the travel, with the underground water, of such pollution for uncertain distances.

This was borne out by the bacteriological examination of about 700 shallow driven wells located in the city and county. The only wells of this kind found free from pollution were those located 200 to 500 yards away from any concentrated source of pollution, as stables or privies. The bacterial counts in those wells not so located were extremely high, and the presumptive tests for colon bacilli almost unfailingly positive.

The above reports are, perhaps, conflicting in places, but it seems clear that the type of soil and the depth of the water table are highly important factors. It seems also that, until further data have been obtained, the borderline cases of high water table and unfavorable soil conditions should be considered dangerous, and that types of sewage disposal liable to polluute the ground water should be avoided as much as possible. In the matter of water supplies, shallow wells drawing from ground waters exposed to such pollution should also be avoided, or, at least, kept under close scrutiny.

A Paving Record in Indianapolis

The 1921 paving record of Indianapolis, Ind., is almost 50% greater than its previous best record, that of 1915. Paving has been completed or contracts have been awarded for a total of nearly 600,000 square yards. During 1918 the amount of paving was reduced to 56,000 square yards because of the war and that done in 1919 was far below normal because of high prices; but in spite of this the total for the four years just ended will reach approximately 1,185,470 square yards, which is little below any previous four-year period. The Board of Works has completed the procedure for several additional contracts, totaling 123,130 square yards, and bids for these will be received shortly after the first of the year.

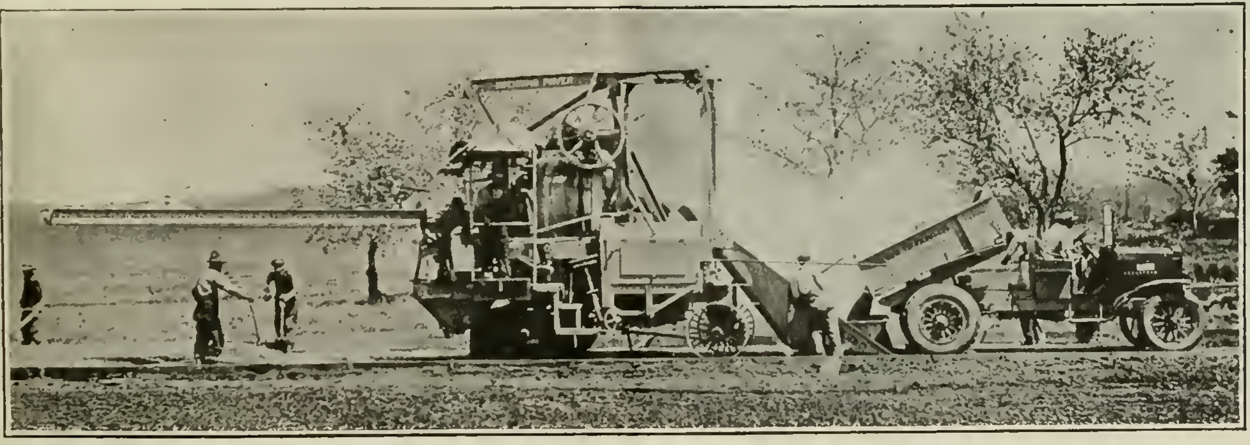
The largest part of the paving during the past four years has been asphalt or bituminous concrete. The work completed or under contract for early completion in 1921 comprised 77,537 square yards of new asphalt, 22,652 square yards of asphalt resurfacing, 170,062 square yards of bituminous concrete, 10,842 square yards of new brick, 5,118 square yards of brick resurfacing, 79,755 square yards of concrete, 3,729 square yards of granite block resurfacing, 10,480 square yards of wood block resurfacing, 17,378 square yards of grading and graveling, and 4.77 miles of grading alone.

Horicon-Beaver Dam Road

Five and one-half miles of 18-foot concrete surface laid in 54 working days. Aggregate for four miles stored at mixer before concreting was commenced. Total force,—fifty-three men.

An important factor of the rapid construction of the Horicon-Beaver Dam road on Route 118, Dodge county, Wisconsin, was the installation of sufficient well selected plant, a thorough co-ordination between the equipment and the operation, and the efficiency of the organization. Care was taken to provide the principal requisites in advance so that no waiting was necessary and the work, except for interruptions, mostly due to unfavorable weather, was carried on rapidly and vigorously with little interference, delay or lost motion.

About two months before the mixer was installed the contractor, the Wisconsin Construction Company, secured a piece of railroad track and right of way about 1,000 feet long with a strip of land 50 feet wide alongside, which he used principally for unloading and storing at Rolling Prairie, the point



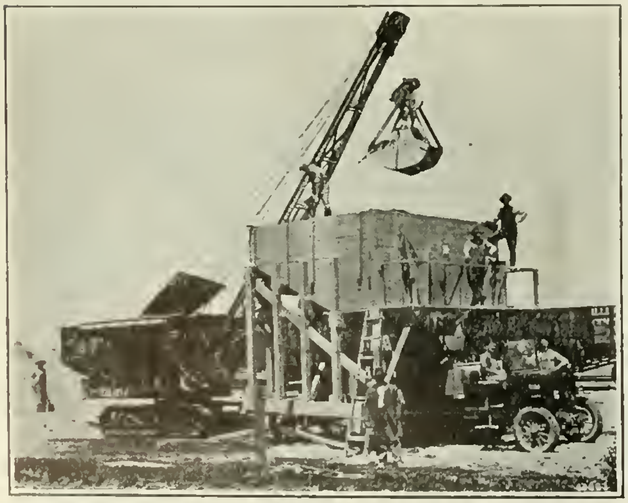
DELIVERING AGGREGATE FROM TWO-BATCH TRUCK TO PAVING MACHINE, HORICON-BEAVER DAM ROAD of railroad delivery. Sand and stone were received at the rate of 10 or 12 carloads daily, and unloaded by a Northwest Engineering Company's locomotive crane with a 40-foot boom and clamshell bucket, which stored the sand and stone in parallel piles respectively 20 feet and 50 feet wide at the base and together containing about 10,000 yards of aggregate, sufficient for nearly 4 miles of roadway.

The derrick also loaded when convenient directly into a small portable storage bin and at other times reclaimed the aggregate and delivered it to the bin, keeping the latter filled to supply by gravity measured batches to the trucks in which it was transported to the mixing machine.

The bin was approximately 41 feet square and 18 feet high, made of white oak throughout. It was mounted on road wheels, 40 inches in diameter and with 12-foot base. Attached by a rigid 10-foot pole to the crane mounted on multiplanes, it was moved forward as the crane moved, thus making unnecessary the peaking of the boom at any time. The bin was supported at three points, on the two rear wheels and on the fifth wheel of the front axle. In this way strains due to uneven bearing were reduced to a minimum. About 15 yards of sand and 25 yards of stone were at all times maintained in the bin. Two measuring hoppers, mounted below the bin floor, were so designed that they could be adjusted to give required proportions of concrete. Levers controlled from the platform operated the upper and lower cut-off gates.

Two-compartment Nash trucks backed under the bin, received 27½ cubic feet of aggregate in each compartment, and drove to the cement shed where they were loaded with 2½ barrels of cement in bags, emptied directly on top of the aggregate. The truck hauled the materials to the site of the work, turned and backed into the skip of the 21-E Koehring paver, discharged the first batch and moved forward about 2 feet. The skip was then raised, the material charged into the drum of the mixer, the skip lowered and the truck again backed into the skip, discharged the second batch and returned for another load.

When mixed, the concrete was discharged into the boom bucket of the spreading type with a door opening transversely instead of longitudinally, that consisted of a single leaf, hinged at the back of the bucket and released by the man on the operator's platform. The concrete was spread in an even layer as the bucket was drawn back. When it was desired to push the concrete into a corner, this was readily accomplished by reversing the motion of the bucket and using its door as a plow. The finishing was done by hand by the use of a strike-off board followed by roller and belt.


FILLING MOVABLE BINS AND LOADING TRUCK

The total crew of 53 men included: 1 crane operator, 10 cleaning up cars and assisting around plant, 7 handling cement at cars and warehouse, 1 bin operator, 1 loading foreman, 11 trucks with drivers, 2 dumping trucks, 1 mixer operator, 6 finishers, 2 form setters, 4 extra men sprinkling and covering cement, 7 or 8 men on grade ahead of mixer.

The day following the placing of the concrete it was protected by covering with earth.

The first mile of highway was built, even with an average round trip haul of between 7 and 8 miles, in 9 working days. This does not mean 9 calender days, for due to rainy weather it was possible to work only 9 days out of 20. This quantity was placed with a green crew and green truck drivers. The work is in charge of P. C. Kroeck, sole owner of the Wisconsin Construction Company, who is being assisted by A. G. Brown and Geo. H. Kies.

Oil Pollution of Navigable Waters

Several cities lying adjacent to navigable waters, and especially harbors used by ocean going vessels, have been troubled with the pollution of the waters by oil from oil-burning vessels. New York and the coasts within its vicinity have been especially annoyed, bathing beaches being spoiled and shipping, docks and other timber structures being threatened by possible conflagration of the oil floating on the surface.

Some months ago a conference was called in New York of business men and others who were interested in the elimination of this oil nuisance and a committee was appointed to investigate the problem and suggest remedies. Since the date of that conference there has been a noticeable improvement in conditions, which has been contributed to the publicity given to the matter of the calling of the conference, to the efforts and public spirit of the maritime and industrial interests in and around the city, and to the cooperaton of the oil companies in collecting waste oil.

The committe reported recently that it was firmly convinced that it is entirely unnecessary for any oil burning ship or plant to dispose of waste oil into or near the waters of the harbor, there being a number of oil salvaging companies that are fully equipped to collect and properly dispose of all waste oil from either ships or plants. In addition to this, there are now practical methods of collecting waste oil by the use of settling tanks or centrifugal separators and there is being developed a system of centrifuges for installation on oil-burning ships that will care for all waste bunker oil, similar to systems which are already in use in commercial oil-burning plants. It is believed that the value of the oil recovered from the waste will pay for the installation in a short time, but unless the various oil-using ships and establishments are induced by arguments of economy to recover the waste oil, they should be required to adopt this or some other plan for eliminating the discharge of oil into harbor waters or in fact into public waters of any kind.

Garbage Disposal for Norristown

A committee was appointed by the borough council of Norristown, Pa., on October 4th to study and report upon the problem of collecting and disposing of the garbage of that borough, and early in December it submitted its report. In this report it states as its opinion that a reduction plant would cost about $150,000 and that the net cost to the borough, after allowing for the sale of grease and tankage, would be about $15,000 a year. In view of this cost and also of the fact that garbage does not appear to be so rich in greaes as it was before the war and that the amount received for garbage grease is very much lower than formerly, the committee does not recommend this plan.

Considering incineraton, the committee was advised that an incinerator suitable for the borough would cost only about $25,000 to $30,000 but that, as there would be no by-products to sell, the net cost would considerably exceed $15,000 per annum.

The only other method considered suitable for the borough was hog feeding, and this the committee recommends. It proposes that the privilege of collecting the garbage be given to "one or more reliable persons who would agree to enter into a contract for the proper collection and disposal of garbage for the entire borough, under an ordinance that would properly protect the borough and citizens of the municipality." The committee had learned that several persons were willing to enter into such a contract and give a bond guaranteeing faithful compliance with it. Most stringent rules and regulations should be made and enforced to provide for a prompt and sanitary collection of the garbage.

In making this recommendation the committee kept in mind the apparent fact that the quality of garbage and methods of disposing of it are in a more or less transition and experimental stage and that it is probable that in the near future some other method may have to be adopted for disposing of it, but in the meantime hog feeding seemed to be the best temporary method of disposal.

The council, on receiving the report, directed the board of health to prepare specifications and advertise for bids in line with the committee's report.

Hydraulic Fill Dam Core Severely Tested

The great Englewood Flood Retarding Dam that is now in an advanced stage of construction by the Miami Conservancy Commission is being built by the hydraulic fill method, in which the material for the high earth embankment is excavated, transported, deposited and compacted by hydraulic methods which are used to place the heavier material in the outer faces of the dam, and to build up the interior with a watertight core, deposited by sedimentation of fine particles of earth, silt and sand carried in the water which forms a pool on the axis of the dam. The rate of overflow and supply to the pool can be regulated so as to govern the dimensions and qualities of the core, as described in previous articles published in this journal.

On the night of October 25th the core pool overflowed on the upstream side of the dam when the latter had been completed to within 12 feet of the top, making a narrow shallow pool 4,600 feet long, the water in which escaped with sufficient violence to cut a deep gulley down the dam slope.

The upper edge of the erosion exposed about 30 feet vertical height of the core, which was so firm that it stood up like a wall and resisted the violent rush of water so well that very little of it was eroded. The portion which was detached was so solid that it broke up in chunks many of which measured over one cubic yard and were found unbroken where they were washed and deposited by the flood. Out of about 7,000 yards of material washed out only a little more than 10 percent was core material and the behavior of the latter was so good as to afford a satisfactory demonstration of the results of the depositing and consolidation processes used in the construction. The eroded face of the core was nearly vertical and the result of the severe test was considered better than could have been expected.

Pulling Sheet Piles With a Luff Tackle

In the construction of the foundations for a large power plant at Bridgeport, some of the excavations had to be carried down 70 feet below water level through earth, boulders and quicksand and there were driven three cofferdams, requiring about 2,000 Lackawanna sheet piles 38 feet long penetrating full length in quicksand.

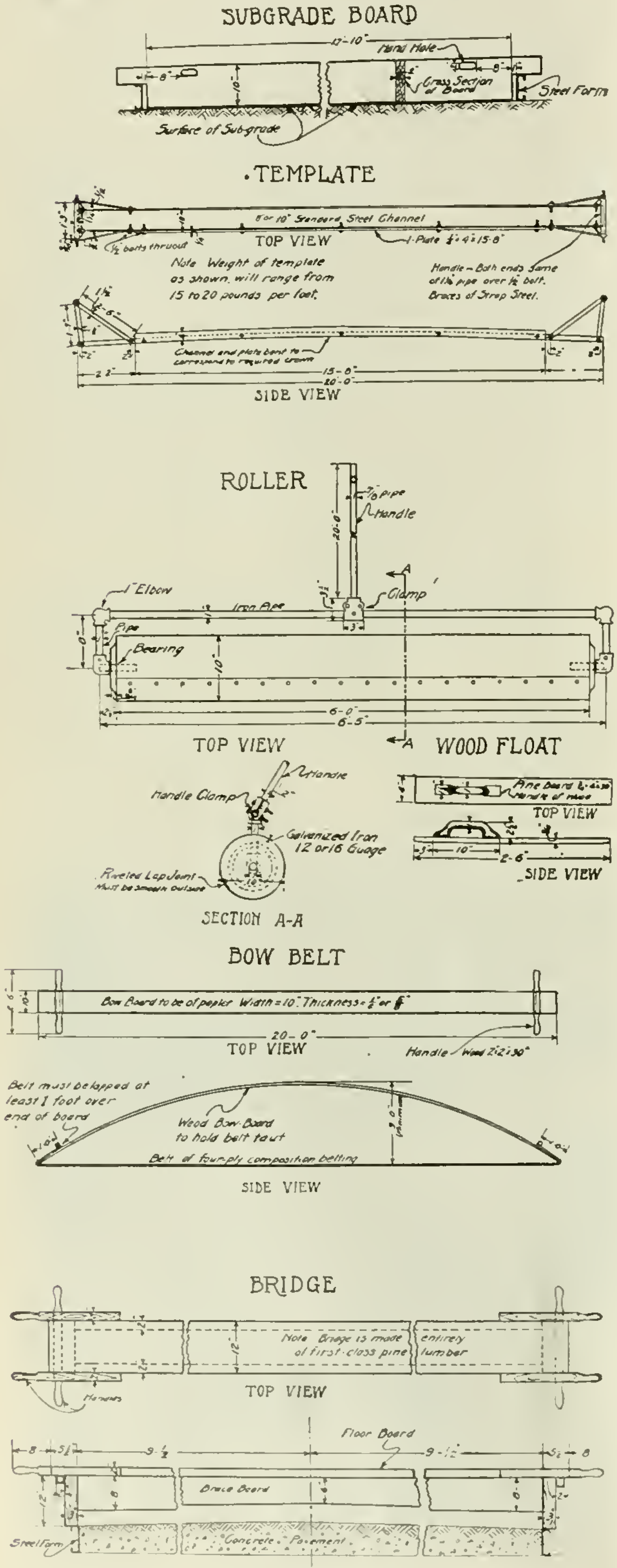
They were driven by a No. 4 McKiernan-Terry steam hammer, handled by a derrick boom, at the rate

CORE EXPOSED AT ENGLEWOOD OCTOBER 26, 1921.

of about 50 piles per 8-hour day. Attempts to pull the piles with the same hammer failed to start them although the 2½-inch connection bolts sheared through the pile webs.

Finally the superintendent for C. W. Blakeslee & Sons contractor, devised a successful method of pulling them with a hoisting engine and luff tackle that developed an estimated strain of about 150,000 pounds. A pair of 5-sheave blocks, weighing about 1,600 pounds each, were rove with ⅞-inch plow steel cable and suspended from an A-frame 48 feet high with 12 x 24 inch-legs braced by 6 x 12-inch struts, and capped with a 12 x 36-inch heavily ironed girder made of three 12 x 12-inch timbers bolted together and guyed by one front and two rear 6-part tackles.

The main tackle was connected to two 2½-inch bolts through the pile web, and its lead line was operated by a 7-foot tackle operated by a 10 x 14-inch hoisting engine. The heavy strain soon equalized the bearings of the two bolts and the piles were pulled at a maximum rate of 10 per day.



DETAILS OF ROAD-MAKING APPLIANCES

Concrete Pavement Construction*

Homemade tools and their use for finishing operations

Special care should be taken to secure smoothness and uniformity of the road surface, regardless of the quality of materials employed, because the smoothness is most apparent and by it the road is judged by the general public. Lack of uniformity on the subgrade is responsible for many cracks in the concrete surface. Many longitudinal cracks might have been prevented by thorough preparation of the subgrade with special scarifing and rolling when the concrete was laid on an old road surface not much below the new one.

Side forms should be of steel, always weighing not less than 6 pounds for hand finishing and 8 pounds per linear foot for machine finishing. They should be braced at frequent intervals, and both alignment and grade should be checked by the inspector just in advance of the concreting; no concrete should be laid until at least 200 feet of forms are in position and as fast as the forms are moved ahead they should be thoroughly cleaned and oiled.

After the side forms have been placed, the surface of the ground should be checked with the subgrade template which may be made as per sketch, or may be finished with a steel bottom edge forming a sharp blade, and have hauling chains attached by which the subgrade can be shaved to an exact profile when the board is drawn over it.

After trimming and testing, the subgrade should be thoroughly wet to avoid undue absorption of water from the concrete. After the concrete has been placed it should be struck off by a heavy steel channel template weighing from 16 to 20 pounds per linear foot so that it will not be unnecessarily raised from the forms that guide and support it, and so that the workmen will move it with a crosswise motion. The weight will also obviate the danger of its being used for tamping, which is sometimes done with wooden templates. The absence of tamping will tend to reduce to a minimum the excess of water in the surface of the roadway.

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*Abstract of paper ready by P. E. Schnepfe at North Carolina Highway Department District Engineers Meeting, August 12.

A few minutes after the concrete has been struck off, the time depending upon the rapidity of set and the condition of the atmosphere, the concrete should be rolled to remove excess water and produce a denser and stronger concrete. The roller shown is made of 12 to 16 gage galvanized iron, is from 8 to 10 inches in diameter, and weighs approximately 60 pounds. The roller should be used transversely across the road from one form to the other and back again, then advance longitudinally 3 feet, be rolled across and back and so on over the entire section, repeating the operation at short intervals for three times, after which the concrete should be rolled similarly but in a diagonal direction to remove any irregularities left by the transverse rolling.

After the rolling, the surface should be finished by a composition belt forming the horizontal chord, about 2 feet longer than the width of the roadway, of an arch bow that holds it under tension while in use and is provided with handles, not shown in the sketch, for its more convenient operation.

The belt should first be applied with a diagonal sawing motion, produced by pulling it transversely and moving it longitudinally at the same time. After going over the surface in this manner the belt should be used a second time with a longitudinal movement only, omitting the transverse movement. The belting should be completed by a third operation consisting of a longitudinal movement.

The upper corners of the concrete should be rounded by an edging tool with a 1-inch radius, after which any imperfections appearing in the surface should be eliminated by a trowel and wood float operated from a light moveable bridge supported on the side forms.

Strips of burlap 3 feet wide and as long as the width of the road should be thoroughly wet, the excess moisture removed by shaking and then they should be spread over the freshly finished concrete and kept wet with a hose until next day when they should be removed and replaced by a thin layer of earth kept wet by sprinkling for several days.

When finishing machines are used they should be handled by competetnt operators and at least three men with shovels should work in advance of the machine to remove excess concrete and leave it about an inch higher than the final elevation after it has been machined. In the first operation of the machine the template strikes off the concrete and the tamp gives it density, the second operation the tamp is dispensed with so that only the template and belt are used, and in the third and last operation the belt only should be used.

Sewage Gas As Motive Power

A paper with the above title was read before the Institution of Municipal and County Engineers of England a few weeks ago by John D. Watson of Birmingham on the occasion of a meeting of the members of that institution in this city. Before the meeting the members inspected one of the city's sewage disposal plants where an application of sewage gas for operating an internal combustion engine was inspected with considerable interest.

The drainage board having approved plans for employing a suction gas engine for pumping the sewage, it was decided to test the use of sewage gas for operating the engine. The plant installed is designed to give 25 hp. for 6 hours a day. It comprises a 34 hp. horizontal gas engine of the ordinary suction type, a 5-inch centrifugal sludge pump, a small sludge pump well, and a sludge digestion tank constructed of concrete in two sections. A small gas holder was necessary, without which it would be impossible to keep the engine running more than one hour and a half or two hours consecutively. Only the amount of sludge required to give off the gas needed for power will be subjected to fermentation, and judging from the limited experience available it was estimated that about two tons of wet sludge (10 percent dry solid matter) per day will be required to provide an explosive gas capable of generating 25 hp. for a working period of 6 hours per day. The amount of sludge available at this plant is approximately 80 tons per day of 10 percent dry solid matter.

Mr. Watson stated that 400,000 tons of wet sludge —27,000 tons of dry solid matter—were dealt with at the main sewage plant of Birmingham every year and 320,000,000 cubic feet is gasified.

In connection with the paper, Mr. Watson read a letter from Lord Elveden who wrote that he had obtained inflammable gas from manure and had run a 2 hp. gas engine with such gas in the raw state as it came from the generator and that this gas had been used for operating a gas stove for cooking, having been collected in an old gas bag similar to those used during the war on motor cars which were being run by gas instead of by gasoline.

Testing and Inspecting Concrete

Concrete is considered by the Ontario Hydro-Electric Power Commission to be a manufactured article, and expert supervision is maintained of both materials and the combining of them.

The Hydro-Electric Power Commission of Ontario is one of the largest manufacturers of concrete in the world. Before the completion of the Queenstown Chippawa power development, over half a million cubic yards of concrete will have been placed by the commission in various structures. This means an expenditure for materials alone of over $3,500,000, and a cost for the labor and plant necessary to convert these materials into concrete of as much more. Obviously the commission is interested in any means of cheapening a product of which it is such a large user and would be justified in undertaking any legitimate steps to this end.

Concrete is not a material of uniform quality. There is good concrete and poor concrete, and unfortunately the latter is not uncommon. Many concrete structures built but a few years ago are to-day showing unmistakable signs of disintegration. Concrete differs from nearly all other structural materials, for it is manufactured upon the site of the structure of which it is to form a part. The steel for a steel structure is manufactured in a highly organized steel mill under rigid control, is then fabricated in a well-equipped structural shop, and on the job it is only assembled in place; but in the case of concrete the only manufactured material used is the cement, the rest of the ingredients being raw materials obtained locally and the whole is combined on the job to form concrete. Making concrete is thus a manufacturing operation.

In manufacturing, a product of uniformly high quality can be obtained only with proper materials processed under the immediate supervision of experts.

This holds true for concrete and for this reason the commission maintains a system of rigid inspection of all materials and processes in its manufacture. The commission some years ago began to study and develop methods for inspecting and testing concrete and concrete materials and for proportioning, mixing and placing them in the field. The methods adopted are thought to be in advance of those of any other large concern in Canada if not in the world. The engineers believe that they are enabled to guarantee the quality of the concrete and in most instances to cheapen its cost.

The methods consist in brief of mill supervision and sampling of the cement to enable the necessary tests to be carried out prior to its arrival on the job, and of laboratory tests to determine its quality. In testing sand and stone, after preliminary studies have been made to determine the suitability of the material and its concrete-making properties, periodic tests of the material as supplied are made to determine its gradation, cleanliness and the proportions of the cement which must be used to obtain the desired results. In addition, the sources of the materials are kept continually under observation.

The proportions of cement, sand, stone and water that, under any given conditions, will give concrete of the desired quality are determined by a method of proportioning known popularly as the "surface area" method, although that used by the commission is somewhat different from this method as generally understood. The modified surface area method was developed in the laboratories of the commission as a result of its experimental investigations and researches. The method is simple and practicable and offers an effective way of determining proportions.

The inspection of concreting operations includes all details in connection with proportioning, mixing and placing. An effort is made to see that all materials are accurately measured, that the batches are properly mixed and that the methods of placing are so arranged as not to interfere with the quality of the concrete delivered. Inspection is also maintained over the preparations preparatory to placing concrete, on its deposition in the forms, on the removal of the forms and on its final finishing. As a check on the correctness of the proportions used and the methods pursued, specimens of the concrete produced are obtained for test periodically. The test specimens are six or eight-inch cylinders. They are taken directly from the wet concrete already in place in the forms and are moulded and cured under standardized conditions. Some are tested when seven days old, others when twenty-eight days old, by crushing them to destruction in a hydraulic press and noting the force required to accomplish this.

Preliminary to actual construction the laboratories examine all available materials and determine those suitable for use. When construction is about to begin they make further studies to determine the proportions which will give concretes of the different classes to be used. During construction a concrete engineer from the laboratories is assigned to the staff of the resident engineer in charge of the job to assist him with the concrete work. Thus at all times close contact is kept between the laboratory and the field.

A field laboratory is installed on each of the larger jobs. This laboratory is equipped with apparatus to carry out the necessary tests and to get the information needed in setting the proportions. The required apparatus is simple and of slight cost and requires but small space to house it. The tests likewise are simple and cheaply made.

The concrete laboratory of the commission is very completely equipped for the investigation of problems in connection with concrete and is staffed with men especially trained in this work.

Municipal Use of Farm Land

In 1910 the city of Philadelphia purchased a tract of land containing something over 1000 acres with a view to using it as the location of a sewage treatment plant. It will be several years yet before the land will be used for this purpose, and meantime no other use appeared possible except the original one of cultivation. Both the land and the buildings upon it were therefore leased to tenants and the city thus obtained a slight return on its investment of over $738,000.

About a year ago, however, the Department of Public Works took over about 350 acres of the property, which had been yielding the city slightly less than $800 during the last two years of tenant occupancy, during which time the improvements had fallen into a bad state of disrepair. The city proceeded to put the dilapidated premises into excellent condition and is using the land as a model farm whereon to quarter the horses used by the Departments of Public Works and Public Safety. In November, 1921, eighteen police horses and 84 public works horses were kept there. A considerable part of the farm is devoted to pasture and about 250 acres were tilled in 1921 and yielded about 2300 bushels of oats, 1500 bushels of corn and 400 tons of hay, which are used by the various city departments. In addition, hens on the farm furnish fresh eggs for the city hospitals. The city this year has not received the $800 rental but instead has produced farm products of much greater value.

This year's work, however, is considered to be only a beginning. With the beginning of 1922 the Department of Public Works will take over the street cleaning of the city and the refuse collection and will have about 2000 horses engaged in this work.

The model farm will be used in connection with assembling these horses and providing pasture and stables for them and for the new animals that must be added from time to time or for horses that need rest or medical or surgical attention.

On the farm is a horse hospital which is said to be second to none of its kind. The floor is cement, each of the 16 stalls is adequately drained, it is abundantly lighted through windows by day and by electric lights at night, and is ventilated by a remarkably complete system. At one end of the building is an operating room with operating table, a mask for etherizing horses and a recovery stall. So attractive and neat is the interior of this stable that in October the American Humane Association held a buffet luncheon in it.

Pennsylvania Policies as to Public Sewerage*

By W. L. Stevenson, M. Am. Soc. C. E.†

Policies adopted by the State Department of Health in administering the "Purity of Waters Act." Degree of treatment of sewage required varies with the conditions of each case.

The Legislature of Pennsylvania in 1905 enacted the "Purity of Waters Act" for the protection of the public health by controlling public water supplies and by prohibiting the discharge of sewage into the waters of the state.

But the act provides that in the case of municipally owned sewers, the Commissioner of Health, with the unanimous agreement of the Governor and Attorney General, may permit the discharge of sewage subject to such conditions as he deems will subserve the general interests of the public health.

The evident intention of this prohibition and provision for discharge under certain conditions is to provide for varying degrees of sewage treatment, so as to maintain the streams in a reasonably clean condition and to make it practically and economically possible to use certain waters of the state as sources of public water supply and for other purposes requiring a hygienic standard.

Streams are the natural drainage channels for rainwater flowing over the surface of the land and conveyed to them by rainwater conduits from the towns of their watersheds.

It therefore follows, even if all sewage were excluded or completely purified, that no surface water from a populated watershed would be fit for use as a public water supply without some form of purification to eliminate the natural contamination of the surface stream.

It is possible to produce a clean, colorless and bacteriologically safe water supply from a grossly polluted and contaminated source. It is also possible to purify sewage to such an extent that it will be freed from all its polluting and contaminating constituents; but both procedures are exceedingly costly and often unreliable.

Therefore, the wise and just administration of the "Purity of Waters Act" should be based upon an economic consideration of the uses and conditions of the various waters of the state so as to secure the greatest protection to the public health by the least expenditure of public and private funds for construction and operation of water purification and sewage treatment works.

The Engineering Division of the Pennsylvania Department of Health is charged, among other things, with the examination of plans of sewerage and sewage treatment works submitted with applications for issuance of permits, also with making field investigations and recommending to the Commissioner of Health the conditions under which permits may be issued.

To obtain as nearly as possible uniform practice in this work, certain fundamental policies, given below, have been erected but it must be borne in mind that the wide range of uses and conditions of the waters of the state makes it utterly impracticable to erect definite detailed policies that will be statewide in application.

In the following, the word "stream" is to be considered to include all lakes, ponds, or other waters of the state, and where policies are given for streams used as sources of public water supplies, they apply equally to streams used for other purposes requiring a hygienic standard, such as bathing and ice harvesting.

CLASSIFICATION OF STREAMS

The problem of administering that part of the "Purity of Waters Act" relative to sewerage has three phases:

(1) Prevention or abatement of nuisance.
(2) Protection of sources of public water supply.
(3) Maintenance of clean streams.

Streams even though they are not used as sources of public water supply, should as a matter of decency be maintained in a reasonably clean condition, i.e., free from sludge deposits on the bed or banks, ebulition of offensive gases, undue turbidity, discoloration, floating solids or any other nuisance to sight or smell of sewage origin.

Streams used as sources of public water supply should, in addition to being reasonably clean, provide a raw water sufficiently low in organic and pathogenic bacterial content that it can be safely and economically purified for domestic purposes.

Small streams flowing through highly developed suburban territories or land devoted to park purposes for the pleasure and recreation of the public, demand a very high degree of protection and should be so clean that they show no appreciable evidence of sewage.

DEGREE OF SEWAGE TREATMENT REQUIRED

The ground water drained or pumped from coal mines contains considerable sulphuric acid which acts as a germicide upon sewage discharged into streams receiving such mine drainage, thus minimizing the danger of creation of nuisance or menace to the public health; also these streams frequently carry large quantities of fine coal which mask any visible evidence of sewage matters.

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*Paper presented before symposium on Stream Pollution and Sewage Disposal, held by the American Society of Civil Engineers.

†Assistant Chief Engineer, Pennsylvania Department of Health.

Therefore, at points reasonably remote from water works intakes, sewage may generally be discharged untreated into these streams, but preferably from the outlets of the several drainage areas and always into the main current of the stream so as to prevent local nuisance at the immediate point of discharge and to more effectively distribute the sewage in the stream and thus take full advantage of dilution by the water of the stream and the germicidal action of the acidity.

If the rate of flow and velocity of streams not used as sources of public water supplies are insufficient to inoffensively assimilate crude sewage, then such a degree of treatment should be required as will lighten the load of organic matter upon the stream so that the desired conditions of cleanliness will be maintained even during times of drought.

The assimilating power of the stream should be equitably distributed among the various municipalities along its course so that one town will not be required to treat its sewage to a high degree because a neighboring community upstream has overtaxed the stream with insufficiently treated sewage.

In the case of streams used as sources of public water supplies, sewage treatment should be required to a sufficient degree to produce an effluent which after being carried by the stream to the waterworks intake below, will not prejudice the safe and economical purification of the water of the stream for domestic purposes.

Ample diluting water and sufficient distance between the waterworks intake and the place of sewage discharge may reduce the required treatement of sewage to a negligible degree.

CLEANING STREAMS

Action taken toward cleaning sewage polluted streams not used as sources of public water supplies or to maintain such streams in a clean condition should be begun at the upper end and progress down stream.

Action taken to protect streams used as sources of public water supplies should be, in general and subject to local condition, begun at the first source of sewage contamination above the waterworks intake and progress upstream.

SEWER SYSTEMS

Every municipality should have prepared and submit to the State Department of Health for approval, a comprehensive plan of sewerage before undertaking the design of new sewers or the extension of existing sewers as may be needed from time to time.

In sewering new drainage areas the comparative cost should be estimated of

(1) Collecting sewage and rain water in separate conduits, and

(2) The use of the combined system with interception of all dry weather flow of sewage and such a percentage of storm water contaminated with sewage as will afford the required degree of protection to the receiving body of water..

In extending existing combined sewers in municipalities having well improved highways, the relative economy of continuing the combined sewers or of replacing them with separate sewers should receive careful consideration in connection with the relative protection afforded to the waters of the state.

Contiguous or adjacent municipalities should be urged to give careful study to the possible advantage of entering into agreements for the joint construction and operation of intercepting sewers and sewage treatment works.

SEWAGE TREATMENT WORKS

In cases where sewage treatment is not required at present, general outline plans of the project should be submitted to the State Department of Health for approval. They need only be prepared in sufficient detail to demonstrate the feasibility of constructing the intercepting sewers and sewage treatment works, to show that the site of the proposed work is properly located, ample in area, and of suitable topography for the erection of treatment works sufficient for the needs of the municipality.

The advance in knowledge of sewage treatement in past years indicates possibility of even greater improvements in the future, hence it is inadvisable to prepare detail plans until it becomes necessary to construct the works.

If the approved site is at all liable to be acquired for private use the municipality should forthwith acquire it, so as to be prepared to treat the sewage when necessary.

In cases where the use and condition of the stream is such that sewage treatement is required at the present the plans should show in detail the portion of the works required for the needs of the present and reasonable future and in general outline the extensions rquired for increased rate of flow and higher degree of treatment probably needed in the more distant future.

The operation of oxidizing processes of sewage treatment works, whose only purpose is to prevent the creation of a nuisance in a stream not used as a source of public water supply, may upon request and with the specific approval of the State Department of Health be suspended during the colder part of the year when the greater quantity of dissolved oxygen and lessened biological activity in the stream will permit the discharge of unoxidized sewage.

Another Rock Tunnel Record.

The Construction Co. of North America, contractor for driving the 11-foot 3-inch rock tunnel in the mountain division of the Hetch Hetchy water supply for the city of San Francisco has recently established a new record for speed in driving a total length of 37,453 feet from the beginning of work in 3,490 shifts, making an average as 6.1 feet per shift in all of the eight headings driven. The best progress made was 776 feet per month, through slate rock. Through granite it varied from 273 to 477 feet per month with 45 to 48 holes per round as compared with 25 holes per round in the slate. In the diorite rock, progress was 406 to 420 feet per month with 25 to 34 holes per round.

PUBLIC WORKS

Published Weekly
at 243 W. 39th St., New York, N. Y.

S. W. HUME, President J. T. MORRIS, Treasurer

Subscription Rates
United States and Possessions, Mexico and Cuba $3.00 year
All other countries ....$4.00 year

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Discretion in Enforcing Sewage Treatment

That every city and smaller community and every commercial plant producing liquid wastes should be required to treat its waste waters so as to bring them within a certain fixed limit of impurity was the idea of sanitarians of a short generation ago. In many cases in New England the effluents of sewage purification plants actually were purer than the streams into which they discharged. England established and re-established standards for effluents which were continually being found impracticable of enforcement.

A more reasonable and enforceable attitude, and one more logical from some points of view, is now taken by sanitarians and law makers. It is recognized that streams must receive drainage from their watersheds until natural laws are superseded by man-made ones, and can not be kept "pure," and that the expense to which communities or individuals can be compelled to go to reduce the amount of pollution they contribute to the streams must be determined by reasonable consideration of the special conditions affecting each case.

The requirements made of some communities, such as those which drain to streams that must be used as a source of water supply, must be more stringent than are necessary in the case of others, such as those draining into salt water or the lower courses of streams already polluted. To draw up laws and regulations that will fit all cases would be impracticable, for each case differs in some respects from almost every other, conditions are continually changing and a standard set of a given city today will not be suitable in five or ten years from now, and knowledge and practical possibilities are continually developing along old and in new directions.

The making and enforcement of regulations governing sewage treatment must therefore be placed in the hands of some commission or individual who is granted powers of discretion in adapting them to individual cases. These administrators of the sanitary powers of the state therefore occupy a very responsible position and one calling for a degree of judgment and wisdom not demanded of most public officials.

It is very gratifying to know that one of our most populous states, and one in which the stream pollution problems are especially difficult of satisfactory solution, has so wisely selected the members of its state health department. Their attitude toward this question is stated clearly and at length in this issue. It is based upon "an economic consideration of the uses and conditions of the various waters of the state so as to secure the greatest protection to the public health by the least expenditure of public and private funds for construction and operation of water purification and sewage treatment works."

Too often state as well as local health departments are placed in charge of physicians who consider their duties to stop with securing "the greatest protection to the public health" and who fail to give any consideration to "expenditures of public and private funds" as something in which they are in no way concerned. In the end the public health will receive much greater protection from the Pennsylvania type of health department than from the narrower-minded ones which encounter opposition at every step because of their inability to realize that even health work is inter-related with public finances and can not expect all other interests to give way to it, or to the present officials' idea of how it should be conducted.

Standardized Contracts

It is universally agreed that the innumerable variations in the forms and requirements of construction contracts are a prolific source of misunderstanding, expense, and delay and there has long been an increasing demand for some uniformity of contract form.

Heretofore the majority of engineers and architects have used the most convenient contract available as a general pattern on which to write a new one, often modifying it far more than was necessary to suit requirements, sometimes with little regard to the actual necessities of the case or even for the apparent purpose of making their orginality impressive. This, of course, causes much confusion and complication, which is increased by the great extent to which contracts and specifications have been confused and the loose way in which classifications and requirements are combined. Another very serious fault is the frequent tendency to write the contracts in an unfair spirit so as to put all of the risk and responsibility on the contractor and keep all the profit and advantage to the owner, with the engineer as the sole arbitrator.

It is probable that many of the disadvantages can be greatly reduced by the rational plan proposed at the recent conference described in this issue. The efforts of this conference, as there outlined, may well produce a reasonably compact foundation, which will serve for many typical jobs and should be, if properly prepared, adopted as widely as possible and modified as little as possible.

It is to be hoped that the proposed standard contract and general conditions will confine the latter as much as possible to recognized standards of materials, methods, operations, workmanship and equipment, with special consideration for unmistakable classifications, interpretations, definitions and thorough provision for changes of quantities, recognition of unforseen contingencies, and just treatment for the contractor in the payment for temporary and auxiliary construction, change of materials, change of plans, and extra services.

In the final analysis the contract and specifications should define and record "the meeting of minds" on the general features of the case and afford a foundation and provide an agreement on predetermined facts, and accepted standards and provide the basis for honest co-operation and concessions between the competent engineer, the contractor and the owner.

The most successful contract forms, however, cannot be universally adopted and there will be many occasion when it will be entirely advantageous to modify them on the unit price basis, the cost plus percentage basis, the cost plus fixed fee basis, the profit and loss sharing basis, and the various combinations of these and other types that have been tried, praised and condemned.

The ideal contract is the simplest and fairest, as short as will cover essential features and intended to clearly deprive essential requirements and responsibilities and promote this most suitable quality of construction, efficiency of work and materials and conserve the rights and interests of both parties when executed wtih honesty and ability.

Bituminous Fillers for Brick Pavements.

At the annual meeting of December 1st of the National Paving Brick Manufacturers' Association, a resolution was adopted and confirmed by the board of governors "declaring the asphalt filled types of brick wearing surfaces as the preferred types of the National Association for general use, without prejudice to other types which may have particular adaptability for special local conditions."

This resolution gives formal assent of the association to a view already embodied in the specifications for 1921 that were issued by it, and therefore perhaps does not call for any expression of surprise on the part of those interested in paving matters. If, however, we refer to the opinions entertained by the association ten or even five years ago we find a most remarkable change in sentiment. Ten years ago the officers of the organization considered it almost criminal to suggest the use of bituminous filler in brick pavements and even up to four or five years ago insisted that no brick pavement was a good pavement unless it had a portland cement filler. The pendulum has now swung to the other extreme and we find the same association preferring the asphalt filler and stating that only under special local conditions is the cement filler adaptable.

The association has not, we believe, gone on record as favoring bituminous concrete base instead of cement concrete, although such base is recommended in this year's specfications, at least for use under certain conditions.

We do not know what considerations have lead to this change of heart, but we have several times taken occasion to set forth at some length in PUBLIC WORKS the advantages of both non-rigid base and bituminous filler; one of these, which would appeal to the city engineers more than to the paving manufacturer, being the possibility of opening up the street at least two weeks earlier than would be practicable where a concrete base and cement filler are used, each of which should be given a week to set before traffic is allowed upon the pavement.

Contract Standardizing Conference

There was recently held, in Washington, a conference of architects, contractors, engineers and others to consider whether something can be done to standardize and generally improve the whole basis of contract forms used in the construction industry where, heretofore, the variation of specifications and terms of agreement has been characterized as "an outstanding sore." Such an improvement of present practice and conditions was represented to make for the elimination of waste and lost motion and improvement of business practices throughout the whole of the United States.

The importance of the subject is indicated by the facts that Brigadier General R. C. Marshall, Jr., formerly chief of the construction division of the U. S. Army during the world war, and now general manager of the Associated General Contractors of America, has recently found through a survey of the situation, that there are today in common use throughout the construction industry more than 200 different forms of contract, none of which has yet been standardzed or made customary in any state or section of the country. This large number of different forms have been analyzed by expert engineers at the headquarters of the Associated General Contractors and they report that the differences are chiefly of wording rather than stipulation and that at least two-thirds of all the provisions of all the documents were common to all of them and might be included in a single contract form. It was found that the stipulations characteristic of building trades, railroads, waterworks and highway construction could be assembled for each of them in standard forms which, under the rules of General Conditions could be added to the single standard agreement form and thus provide a standard contract to cover all cases of construction in all fields, by selecting the proper General Conditions which might probably be reduced to about six to cover the main subdivisions of construction wrok.

This plan together with a "tentative outline" was submitted for consideration to the American Association of State Highway Officials, American Engineering Council, American Institute of Architects, American Railway Engineering Association, American Society of Civil Engineers, American Waterworks Association, Associated General Contractors of America, National Association of Builders Exchanges, and the Western Society of Engineers.

All made favorable responses and appointed representatives to come to Washington to constitute a conference on the subject and proceed with the drafting of a tentative form of contract which could later be offically submitted by the conference to its constituting bodies for criticism, amendments, and ultimate ratification.

The conference met in the assembly room of the Department of Commerce building, in Washington, December 15 and 16. The aim of the conference in beginning work on this difficult task was to achieve the following advantages for the entire construction industry and all its affiliations: Less expenditure and legal service. Less duplication of work in the professions. Elimination of disputes. Better safeguard for owners and increased public confidence. An improved standard of construction service throughout the country.

Officers of the Conference were elected as follows: Chairman, Onward Bates, Chicago; Vice-Chairman, J. W. Cowper, Buffalo; Secretary, W. P. Christie of Washington, D. C. General R. C. Marshall, Jr., and William B. King, representing respectively the Associated General Contractors and the American Bar Association were elected members of the conference. Other delegates were: W. A. Rogers, Chicago; E. W. Reaugh, Cleveland; A. P. Davis for the Engineering Counci,; J. Waldo Smith, New York City; William S. Parker, Boston; H. K. Bishop, Washington; H. Eltinge Breed and W. D. Faucette.

The final session of the conference was devoted to a detailed study of clauses which could be approved for incorporation in the standard contract "agreement," the members voting on each topic separately until a definite list of topics had been made which seemed acceptable for universal use.

It was the concensus of opinion that such a universal document could be achieved, and its scope or length would have to be determined after prolonged considerartion of each topic in detail.

It was also decided that sub-committees should later be appointed in each phase of the industry to draw up the standard form of "general conditions" (one for the railroads; one for the builders; etc.) which would complement the general "agreement" according to the nature of the job.

Thus the general principles of the universal contract were fixed, and a committee consisting of General Marshall for the constructors, W. S. Parker for the architects and W. D. Faucette for the Railway Engineers, was appointed to write out the document in tentative form for correction and approval by transmitted officially to the various societies and organizations interested for further consideration and ultimate adoption.

Lackawanna Trail

The contract for 6½ miles of concrete highway pavement on the Lackawanna Trail between Nickelson and Foster, Pennsylvania in the State Highway Systme was awarded for $420,000 to the Awixa Corp., Islip, N. Y., who commenced operations June 16, 1921 and expect to complete the work within one year from that date. The road, 20- feet wide from 6 to 8 inches in thickness, is constructed on a new alignment in hilly country with maximum grade with 3½ percent grades and curves of 6 degrees. It involves the excavation of about 25,000 yards of earth and 25,000 yards of rock, a maximum haul of about ½ mile. The total amount of concrete required is about 35,000 yards, besides 1,500 yards of culverts. Aggregate is received by rail and unloaded by a crane and immediately delivered to the mixer without intermediate storage. It is taken in automobile trucks to the 21-A Koehring paving machine and to the Koehring Dandy Mixer for culvert work. The maximum progress has been so far 1,096 square yards in eight hours and the total force of 135 men with a weekly payroll of about $4,000.

Grading was done with Bucyrus steam shovels, served with four 4-yard trucks and water was pumped by the contractor's C. H. & E. pumps delivering through a maximum of 4 miles of pipe.

Decision in the Hetch Hetchy Suit.

(From the December number of "The City," the monthly publication of the San Francisco Bureau of Governmental Research.)

The right of citizens to inspect municipal business, not after it is settled, but while it is in the formative stage when criticism may be of real value, is at last definitely established. Last week the Supreme Court of California, in the Bureau's Hetch Hetchy suit against the city and county of San Francisco, handed down a decision ordering that all the records and data sought by the bureau in its action be made available to it for inspection. This is of far-reaching importance, as it settles in favor of the taxpayers the right of citizens to take an active part in their own affairs as administered by municipal officials.

The bureau in 1917, wishing to make an independent and accurate study of the Hetch Hetchy project, after informal, and later formal requests, was denied access by the city engineer to certain information relative to diamond drill borings, dam location plans, cost estimates, stream flow studies, etc. The city engineer's recommendation that the bureau be denied the requested information and opportunity to scrutinize records, estimates, etc., was supported by the mayor and upheld by the Board of Supervisors after formal hearing.

Two suits were then filed, one by the bureau in its own name and one by the secretary of the bureau, as a taxpayer. A trial was had before Judge Crothers, and the Court handed down a decision upholding in part the bureau's contentions, but deciding that certain kinds of data need not be opened to inspection. The city appealed from this decision, and the bureau appealed from that part exempting "working papers," inasmuch as all data and investigations that had not been formally filed with the Board of Public Works by the city engineer, and all data turned over to the city attorney for his information in trial cases would have been exempt from citizen scrutiny if the decision were permitted to stand. (The city contented that working reports and other data did not become public documents until they had been transmitted in a formal report from the city engineer to the Board of Public Works, and further, that all data, when turned over to the city attorney, became "confidential" in character.)

In the meantime, the bureau and the city engineer were in conferences on many other matters; much of the data originally sought by the suit had been made available at various times to the bureau's representatives and to citizens generally, and specifications had been published and the contract let for construction of the dam. The suit was not dropped, however, because of the public-spirited desire to definitely establish the right of all citizens to have a knowledge of all public business, and not only such as a public official might choose to disclose or as might be disclosed in formal official reports.

This right is definitely established by last week's decision, which orders included within the writ of mandate for citizen inspection all preliminary estimates and details which form uncompleted data, even although such matter may not yet have been formally dignified by official sanction as public records; and further, that citizen inspection of records and "other matters" cannot be prevented on the ground that they are "confidential" by the circumstance of the city engineer's having communicated these to the city attorney.

The Cost of Water Waste.

In his annual report for the year 1920, George G. Earl, general superintendent of the New Orleans Sewerage and Water Board, explains clearly the disadvantages to the taxpayers of waste of water, in this case caused partly, Mr. Earl believes, by the too low rates for water. This part of the report is as follows:

> From 1915 to 1920, with only 20% increase in the number of premises served, the total water consumption has increased about 55%, having now reached an average daily rate of consumption for several months of 1920, of about 43,000,000 gallons per day, which is the safe capacity limit of the existing purification and pumping plants. This limit has been reached by 1920 because the total average consumption has gone to very nearly 100 gallons per day per capita; whereas, in 1915, every thing indicated that a total average consumption per day per capita of 80 gallons, would suffice. If this assumption had held, the necessity to increase the present plant capacity which exists today at 100 gallons consumption per capita for 400,000 people, would not have arisen until at 80 gallons consumption per capita, there were 500,000 people. In other words, the increased per capita total consumption is forcing increases in capacity in water and sewerage systems, which will cost several million dollars, over ten years before they would otherwise be necessary, and this increased and increasing consumption exists, to a considerable extent, because the existing water rate is too low to interest the public at all toward a reasonable care in the prevention of the waste of water. Water consumption dominates both the first cost and the cost of maintenance and operation of the water and sewerage systems. When the water and sewerage systems lack, as they do now, a safe surplus capacity beyond that required to meet the frequent demands which are made upon them. the tax payer who is already paying out of taxes the interest on the outstanding debt against them, must pay in addition the cost of all necessary increases in capacity. Directly or indirectly, every one is a tax payer, and generally every indirect payment is greater by a toll exacted enroute than the direct payment would be, so that water rates which are too low to interest consumers in water waste prevention and results in the necessity for the expenditure of millions of dollars for increases in capacity years before such expenditure would otherwise be necessary, actually cost through taxation far more than they save in rate payments. This is obvious because no one other than the tax payers and rent payers of New Orleans is ever going to pay any part of the cost of Water, Sewerage, or Drainage service. Every unnecessary increase of capacity in sewerage and water works systems required by waste of water and every unnecessary mile of water mains or sewers built ahead of a proper and healthy continuous and contiguous (but not crowded) growth of urban area to serve a too widely scattered population, is adding unnecessarily to the first cost and to depreciation and maintenance and operation costs, for which no one other than the New Orleans tax payers or New Orleans rent payers will pay.

Algae Tastes in River Water

Tastes and odors in water supplies resulting from the presence of algae in reservoirs and lakes are more or less common, but similar conditions in river water have not often been noted. Rahway, N. J., has for some time experienced intermittently unpleasant odors and tastes which it thought might be contributed by the wastes from a chemical plant located higher up on the stream. At the request of the city, the state board of health, represented by Messrs. Daniels & Whitehead, investigated the conditions and reported thereon a few days ago.

In the report it was stated that uroglena as well as asterionella and other diatoms were found in the river water and that the cotton used in straining out these microscopic organisms in making the investigation had a peculiar fishy taste and odor similar to that complained of by the citizens in the public water supply, and the inspectors expressed as their opinion that these microscopic organisms were responsible for the tastes and odors. The following is quoted from their report:

> "Although in the past there has been practically no trouble experienced with algae growths in the Rahway river, it is evident that periodical difficulty in that direction is liable to occur.
>
> "The protozoa themselves are intercepted by the filters, but the oil from ruptured and dead organisms passes through to consumers and causes the odor. A very minute quantity of oil is sufficient to occasion a very pronounced odor. There is nothing unhealthful about it, but the odor and taste are extremely unpleasant and should, of course, be eliminated."

It was the opinion of the inspectors that it would be impossible to use copper sulphate in combatting the algae growth to be found in the river.

> "The remedy must be obtained by constructional improvements at the plant, as the plankton organisms cannot be satisfactorily and finally eliminated by any reasonable method. This instance it is the uroglena, one of protozoa, and next time it may be algae or something else. It may disappear in a week or persist for months, unless temporary improvement is effected.
>
> "Only a partial remedy is available, that of aeration of the raw water before going into the sedimentation basin. Waldo S. Coulter, bacteriologist, employed by city, has recommended the installation of this aerator following the algae troubles which occured about July 30, but according to him no action has been taken pending the report of the investigating committee on the present water supply."

In regard to aeration of the water Mr. Coulter stated a permanent aerator for five million gallons daily would cost $5,000 and a temporary unhoused wooden aerator could be erected for $1,000.

Recent Legal Decisions

INSUFFICIENT DESCRIPTION OF DEFECT IN STREET IN NOTICE OF CLAIM FOR INJURY

Requirements in statutes and ordinances regulating the method of presenting claims for injuries sustained through defects in streets are constitutional, reasonable and in the furtherance of justice. They are also mandatory; and a substantial compliance with the conditions imposed is a condition precedent to the maintenance of an action against a municipality. The Washington Supreme Court holds, Hanan v. City of Wenatchee, 201 Pac. 5, that the recital in a notice of claim, required by statute, that the injury was caused "by defective sidewalk located on the northerly side" of a named street, does not accurately describe a defect, and is not a compliance with the technical requirement of the statute. Nor is it a compliance with the purposes of the statute. Statutes of this sort have a number of purposes. One of these is to give the municipal officers notice of the nature of the defect which caused the injury on which the claim is founded in order that they may pay or otherwise settle the claim before the municipality is mulct in costs. This right is denied them unless the particular defect is pointed out to them. It is a matter of common knowledge that many of the sidewalks in the municipalities are defective in some respects; but not all of these defects will give rise to a cause of action even though they cause an injury.

EMPLOYEES OF RAILROAD USING CITY STREETS UNDER FRANCHISE DISQUALIFIED FOR CITY OFFICE UNDER KANSAS STATUTE

Where a railroad company uses certain streets and alleys in a city under ordinances granting it the right to occupy them with its tracks upon condition that it shall conform to certain requirements, including the keeping the track in good condition with respect to general travel, the paving of the track between the rails, and the maintaining of a driveway and sidewalk for the public, the Kansas Supreme Court holds, State v. Grove, 201 Pac. 82, that one who is employed by such company as a boiler maker is disqualified to hold the office of city commissioner, under the Kansas statute providing that no employe of a railway corporation operating under a franchise granted by a city, or having any contract with it, shall hold any city office. The term "franchise" is used in this statute in a broad and general rather than a narrow and technical sense, and covers rights acquired under such ordinances, and the relations of the city and railway company under such ordinances are contractual.

"COUNTY OFFICER" DEFINED

The California Supreme Court, in Coulter v. Pool, 201 Pac. 120, defines a "county officer" as a public officer who fills a position usually provided for in the organization of counties and county governments, and is selected by the political subdivision of the state called the "county" to represent that governmental unit, continously and as part of the regular and permanent administration of public power, in carrying out certain acts with the performance of which it is charged on behalf of the public.

"SIDEWALK" AND "PAVEMENT" HELD NOT SYNONYMOUS

In a suit to restrain an assessment of property for street improvement purposes, the sole question was whether or not the terms "sidewalk" and "pavement," as used in the proviso of the city charter imposing an assessment for building or repairing "any sidewalk or pavement" are exact synonyms. The Oregon Supreme Court, James v. City of Newberg, 201 Pac. 212, holds that each word, as used in the statute, has a distinct meaning.

STREET IMPROVEMENT ASSESSMENT NOT VOID BECAUSE PROPERTY NOT WITHIN DISTRICT IS BENEFITED

The California courts hold that the proceedings which form the basis of assessment liens for street improvements will not be considered void because all the property benefited by the improvement was not embraced within the district assessed for such work, since the question as to the limits of assessment districts in the matter of making such improvements is one that is committed solely to the discretion of the municipal body determining upon such improvement under the district plan. Larsen v. City and County of San Francisco, 182 Cal. 1. Stokes v. Watkinson (Cal.) 201 Pac. 134.

NATURE OF HIGHWAY IMPROVEMENT FOR INDIANA VOTERS PETITIONING THEREFOR

The Indiana statutes as to the improvement of highways, Burns' Ann. St. 1914, §§7713, 7716, 7649, 7668, and Burns' Ann. St. Supp. 1918, §§7711a, 7712, 7719, make the questions what improvement shall be made, and whether along an existing highway or along the line of a new one laid out and established for that purpose, exclusively for determination by the qualified freeholders and voters of townships affected; jurisdiction is conferred by filing a petition signed by the required number of qualified freeholders and voters, and may be taken away by an adverse vote of the legal voters of the township, or, in the case of improvements not submitted to a vote, by the remonstrance of a sufficient number of freeholders and voters affected. And neither the viewers nor the board of commissioners have any power to lay out, establish, or construct any improvement except as petitioned for by a sufficient number of properly qualified freeholders who are voters. Cincinnati, I. & W. R. Co. v. Board of Comrs. of Fayette County, Indiana Supreme Court, 132 N. E. 406.

PUBLIC UTILITIES' COMMISSION HAS NO JURISDICTION OVER DANGEROUS CONDITION OF STREET THROUGH LEAKING WATER MAIN

The Colorado Public Utilities Commission, dismissing for want of jurisdiction a complaint against leakage in a water main, Taylor v. City of Glenwood Springs, holds that the Commission has no jurisdiction as to the dangerous condition of a street caused by the leakage of water undermining the street and the holes excavated therein in the work of repairing the pipe line. It cannot order repairs or improvements in a water main except upon complaint of a patron of the utility that the leaks in the pipe line are responsible for an inadequate, insufficient, or impure supply of water.

NEWS OF THE SOCIETIES

CALENDAR

Jan. 4-14 — CLEVELAND, OHIO, BUILDING EXPOSITION. Municipal auditorium, Cleveland, Ohio.

Jan. 5-6 — AMERICAN ENGINEERING COUNCIL, FEDERATED AMERICAN ENGINEERING SOCIETIES. Annual meeting. Washington, D. C.

Jan. 6—DETROIT ENGINEERING SOCIETY. Secretary, O. H. Dawson.

Jan. 9 — MEMPHIS ENGINEERS' CLUB. Memphis, Tenn. Secretary, A. S. Fry, Memphis.

Jan. 10—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary, N. L. Nussbaumer, 80 W. Genesee St., Buffalo.

Jan. 12 — ENGINEERS' CLUB OF DES MOINES. Des Moines, Ia.

Jan. 12-14—HIGHWAY ENGINEERS' ASSOCIATION. Baltimore Hotel, Kansas City, Mo. Secretary, C. W. Brown, State Hgwy. Dept., Jefferson City, Mo.

Jan. 13 — ENGINEERS' CLUB OF SEATTLE. Seattle, Wash. Secretary, Lyman T. Banks, 916 L. C. Smith Bldg., Seattle.

Jan. 14—LOUISIANA ENGINEERING SOCIETY. New Orleans. La.

Jan. 17-19 — IOWA ENGINEERING SOCIETY. 34th annual meeting. Sioux City. Secretary—Lloyd A. Canfield, Des Moines, Ia.

Jan. 17-19—ASSOCIATED GENERAL CONTRACTORS. 3rd annual meeting. Hotel Winton, Cleveland Ohio.

Jan. 17-19—ASSOCIATED BUILDING CONTRACTORS OF ILLINOIS. Chicago, Ill.

Jan. 17-20—ASSOCIATION OF CANADIAN BUILDING AND CONSTRUCTION INDUSTRIES. 4th annual conference. Royal Connaught Hotel, Hamilton.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Jan. 18-19—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. New York City.

Jan. 18—ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS. Annual meeting. Secretary, Miss C. B. Adams, 3817 Olive St., St. Louis.

Jan. 18—SIOUX CITY A. A. E. Joint meeting with the Iowa Engineering Society convention. Sioux City, Ia.

Jan. 20—BRIDGE BUILDERS' AND STRUCTURAL SOCIETY. New York City.

Jan. 24-26—ILLINOIS SOCIETY OF ENGINEERING. 37th annual meeting. Decatur, Ill.

Jan. 27 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Bldg., New York City. Secretary—G. I. Rhodes, 115 Broadway, New York City.

Jan. 27-28 — WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION. Kansas City, Mo.

Jan. 27-28—ARKANSAS CHAPTER, A. A. E. Little oRck, Ark.

Jan. 30—SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention Cleveland. Secretary Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING, 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' building, New York City.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Auditorium, Cleveland, Ohio.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATER-WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

DETROIT ENGINEERING SOCIETY

On December 16thinthe Board of Commerce auditorium, Detroit, was held a .meeting of the Associated Technical Societies of Detroit, sponsored by the Michigan Chapter of the American Society of Heating and Ventilating Engineers. Prof. J. D. Hoffman, head of the mechanical engineering department of Purdue University, addressed the meeting on "Benefits Derived Through Co-operation."

ENGINEERS' SOCIETY OF MILWAUKEE

A meeting of the Engineers' Society of Milwaukee was held on December 21st at the Milwaukee Athletic Club. An address on "How Better Lighting Interests You," was given by W. T. Blackwell, manager of the Commercial Engineering Dept., Westinghouse Lamp Co., under the auspices of the Milwaukee branch of the Illuminating Engineering Society in conjunction with the Milwauke Better Lighting Campaign.

KANSAS ENGINEERING SOCIETY

The annual meeting of the Kansas Engineering Society was held on December 22-23 at Hutchinson, Kansas, comprising business sessions and sessions for the preentation of profeional paper. At the evening session on the 22nd addresses were presented by P. F. Walker as president of the society and by P. J. Ruckel of Hutchinson, Kansas, on "Industrial Activities and Matters of General Engineering Interest in Central and Western Kansas." On the afternoon of the same day a dinner was given tehe society by the Hutchinson Engineers' Club. At all the various sessions, conservation and the public service character of engineering work was stressed.

BOSTON SOCIETY OF CIVIL ENGINEERS

A special meeting of the Boston Society of Civil Engineers will be held at Tremont Temple at 7.45 p. m., December 28th for discussion on tentative specifications for concrete and reinforced concrete prepared by a joint committee from the American Society of Civil Engineers, American Society for eTsting Materials, American Railway Engineering Association and the Portland oCncrete Association. The discussion will be opened by Leonard C. Wason.

ENGINEERS' CLUB OF THE LEHIGH VALLEY

The Engineers' Club of the Lehigh Valley has elected as president W. O. Hearsey, division superintendent of the Bethlehem Steel Co., and as manager W. M. Kelsey, general superintendent of the New Jersey Zinc Co., Palmerton, Pa.

CONFERENCE ON CONSTRUCTION CONTRACTS

Secretary of Commerce Hoover opened a conference of constructors, architects and engineers in the Assembly Room of the Department of Commerce, Thursday morning, December 15, to consider the adoption of standard contract forms for all classes of construction work. The meeting was called to consider the suggestion of the Hoover Report on the Elimination of Waste in the Building Industry, that present contract forms need revision.

The representatives of important organizations delegated to attend the conference included Wm. Stanley Parker of Boston, Secretary, American Institute of Architects; W. D. Faucette of Norfolk, Va., Chief Engineer, Seaboard Air Line, representing the American Railway Engineering Association; H. Eltinge Breed of New York, representing the American Society of Civil Engineers; J. Waldo Smith, Chief Engineer, New York Board of Water Supply, representing the American Water Works Association; A. P. Davis, Director, U. S. Reclamation Service, representing the American Engineering Council; Mr. Onward Bates, Bates & Rogers Construction Co., Chicago, Ill., representing the Western Society of Engineers; J. W. Cowper, President, John W. Cowper Co., Buffalo, N. Y., representing the Associated General Contractors of America; E. W. Reaugh, President, Reaugh Construction Co., Cleveland, N. Y., representing the National Association of Builders' Exchanges.

The purpose of the conference, as set forth in a memorandum accompanying the letter of invitation to the several associations represented, was to select the general principles applicable to all kinds of construction, and the special provisions complementary thereto but applicable only to individual classes of wrk, and from these (1 to create a Universal Document which will contain standard provisions for all classes of construction work and (2) to establish individual standard contract forms for each type of construction, such as have been developed for buildings by the American Institute of Architects and for railroad construction by the American Railway Engineering Association.

Itis hoped, that this will result in:

(1) Less expenditure for legal services in drawing proper contracts, and the elimination of disputes over contracts already drawn.

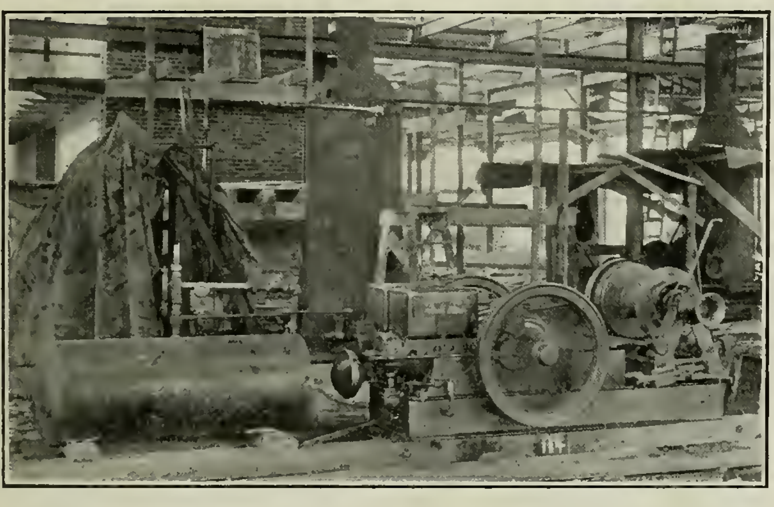
(2) Less duplication of work in the professions attendant on construction.

(3) Better safeguard for owners and increased public confidence, and,

(4) An improved standard of construction service throughout the country.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



HOIST OPERATED BY ONE MAN. MOUNTED WITH AIR COMPRESSOR, ELIMINATES TWO MEN NECESSARY FOR STEAM HOIST AND COMPRESSOR IN BACKGROUND THAT IT WAS REPLACED

O. K. AIR COMPRESSOR AND HOIST

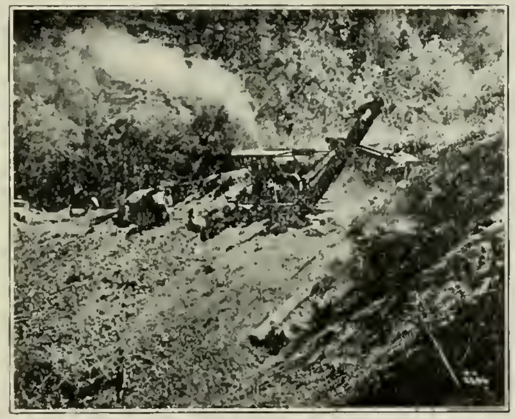
A combined air compressor and hoist, manufactured by the O. K. Clutch & Machinery Co., has been installed for the erection of bridges, structural steel work, tanks and other purposes by many of the large erection and construction firms.

They are very simple, durable and compact and effect a considerable economy of space, labor, power and transportation. The machine shown in the engraving has replaced the hoist and compressor shown in the background and its use eliminates the services of two men necessary for the operation of those separate units. The photograph was taken during the erection of the new factory of the Electric Storage Battery Co., Philadelphia, and shows equipment having 11 h.p., 4-cycle, single cylinder, horizontal type engine with 7¼-inch bore and 9-inch stroke, with capacity of 55 to 65 piston displacement per minute. It is direct connected to the engine by a double throw crank shaft. The hoist has a capacity of 2,200 pounds and the shipping weight of the unit mounted on steel channels, and without air tanks for trucks, is 5,400 pounds.

The first unit of the No. 3 compressor hoist was sold in 1916 and is still in operation giving excellent service on tank and tower work.

P. & H. GASOLINE SHOVEL IN MOUNTAIN ROAD WORK

The accompanying illustration of the Bear Creek Road job shows an interesting application of a Pawling & Harnischfeger gasoline-driven power shovel used by the contractor, C. Miles. This road work, 3,000 feet above sea level in the Santa Cruz Mountains was done at a figure 30 cents per cubic yard less than estimated by experienced excavating contractors and illustrates that the freedom of movement of a gasoline-driven shovel is an important factor. The work was done by excavating one side of the road and over-casting to form the other half. Because of requiring no water pipe line to the shovel, it may be operated in remote locations far aawy from source of supplies. The gasoline fuel used in comparatively small amount is easier to supply than coal, wood or crude oil. The corduroy traction gives the mobility needed to operate continuously, one man on the shovel having all movements of the bucket and machine under his control. The services of licensed engineer and firemen are not required.



P. & G. GASOLINE SHOVEL IN DANGEROUS MOUNTAIN ROAD WORK

INDUSTRIAL NOTES

The thirteen Meyers Whaley Shoveling Machines now installed on the main tunnel of the Welch-Weterly Aqueduct for the San Francisco water supply are credited in the report of city engineer M. M. Shaughnessy, with unquestionably accounting for "the maximum progress with minimum cost for the work; the average cost of 2,915 feet of rock tunneling, exclusive of ooverhead and plant charge being $27.46 per lineal foot. for labor and material."

This tunnel, 11½ feet in diameter and 19 miles long, is blasted in sections 9 to 13 feet long, for which this drilling and shooting is done in 14 to 16 hours, simultaneous with the mucking. When executed by hand the mucking costs $109.50 and takes 19 to 21 hours; by machine it costs $33.00 and takes 3 to 5 hours, making a net saving per shaft of $76.50 and 16 hours time.

The H. W. Clark Company announces an increase in it's Capital Stock from $75,000.00 to $200,000.00 ($150,000.00 common and $50,000.00 seven per cent preferred cumulative).

A one hundred per cent stock dividend was declared out of the earnings of the Company, and some of it's common stock as well as some of the seven per cent cumulative stock is offered for sale.

PERSONALS

Taylor, Alfred A., for several years general superintendent of the department of street cleaning of New York City, has been appointed commissioner to succeed John P. Leo, resignde.

Mack, Macklin has been appointed engineer for the city planning commission of Indianapolis.

Buck, C. D., formerly assistant to the chief engineer, Delaware state highway department, has been promoted to the position of chief engineer.

Sheridan, Lawrence V., an engineer of Dallas, Tex., has been appointed executive secretary of the Indianapolis planning commission.

Miles, E. L., of Lindsay, Ont., road superintendent for Victoria county, has been apopinted county engineer, and will hold both positions.

Haden, J. G., of Clay Center, Kansas, has been appointed water and light superintendent for Horton, Kansas, to succeed R. J. Wolfe, who recently resigned.

New Catalogs of Interest to City and County Engineers, Superintendents of Water Works, Superintendents of Streets, Contractors and All Engaged in Public Works

If you want any of these Catalogs, write the number on a postal, sign your name and address plainly, and mail it to PUBLIC WORKS, 243 W. 39th St., New York. The Catalogs will be sent to you promptly without charge or obligation

AUSTIN MOTOR SWEEPER

229. Austin-Western Road Machinery Co., 2218 Market St., Philadelphia, Pa. Catalog G, 9 x 12 inch, 20 pages, illustrated, heavy paper, printed in colors. Describes improved 4-wheel type Austin Motor Sweeper, illustrated with photographs of actual standard machines, taken before shipment or in operation and by accurate line drawings made by tracing photographs of the parts shown. Without damaging the pavement the machine will pick up dirt, elevates it to the hopper, carries it to dumping point and discharges it, eliminating, without extra cost or service, several different kinds of labor and expense items required under other street cleaning methods. The catalog illustrates brooms, elevators, water systems, chassis, and dirt container. The entire apparatus can be easily handled by a single man competent for truck driving

PUMPING MACHINERY

230. Advance Pump & Compressor Co., Battle Creek, Mich., bulletins 201, 202 and 204 to 220 inclusive, fastened in adjustable stiff paper covers. Descriptions, specifications and illustrations of centrifugal and plunger steam, power pumps for boiler heating, water works, irrigation and other purposes.

BUTT-JOINTS NESTABLE CULVERTS

231. Chattanooga Road Machinery Co., Chattanooga, Tenn. 6 x 9 in., 20 pages illustrated descriptions of culverts made with semi-cylindrical sections of corrugated steel keyed together on longitudinal reinforcing ribs.

BUCYRUS CLASS-72 TRENCH EXCAVATOR

232. Bucyrus Co., S. Milwaukee, Wis. Bulletin T-1002, describing Bucyrus Class-72 Trench Excavator with capacity for digging trenches in hard soil up to 72 inches wide and 20 feet deep, mounted on caterpillar traction and built with shovel type of construction to insure great strength and durability.

SMITH MIXERS

233. "On the Job with Smith Paving Mixers" is the title of a new Catalog (No. 409-B), issued by The T. L. Smith Co., 1125 32d Street, Milwaukee, Wis. Photographs taken on various jobs throughout the country of all sizes and types of Smith Paving Mixers, are featured, and also illustrate the various types of auxiliary equipment used by road contractors—industrial railway and batch boxes with paver derrick, dump body trucks, automatic loaders, wheel barrow loading, etc. Mechanical points of particular interest in Smith Papers are shown by means of actual photos. Copies of this new catalog 409-B will be gladly sent free on request.

LAND DREDGES

234. Bay City Dredge Works, Bay City, Mich., catalog B, 10 x 6½ in., 78 pages, illustrated, embossed heavy paper covers, halftone engravings and descriptions of special features of dredges of the crawler, walking, track and floating types and data of work executed under unusual conditions, road work, and highway excavations, sewer tile and ditch excavations

STEEL SASH

235. Truscon Steel Co., Youngstown, O. 8½ x 11 in., 80 pages, illustrated, showing detailed drawings and photographs, together with specifications and descriptions of the features of steel side wall sash for counterbalancing—continuous sash, mechanical operators, standard and special partitions and channel and tubular doors.

HYDRAULIC AND SANITARY EQUIPMENT

236. The Sanitation Corp., 165 Bdwy, New York City. Bulletin G-6, 8 x 10½ inches, 40 pages, illustrated descriptions of sanitation—Geiger gate, valves and control apparatus, Olier automatic pumping machinery and ejectors, sanitation-Wuurl rapid sand filters and Larner-Johnson valves.

HOISTING MACHINERY

237. Catalog 24 of Street Bros. Machine Works describes and illustrates a large line of standard steam and electric hoisting machinery, including cableway engines, cargo hoists, derricks for all purposes, dredging engines, excavating machinery, swinging engines, windlasses, drill frame hoists and many other special appliances.

WELLER STORAGE PLANTS

238. Weller Manufacturing Company, Chicago, bulletin 105, 7½x10 inches, 32 pages, illustrations and descriptions of unit systems steel bins for storage for large or small quantities of sand, gravel, broken stone, coal and other materials. Crushing, elevating, conveying, screening and washing plants, cement unloaders, car unloaders and car fillers.

HEATING AND STORING TANKS

239. Walter E. Mills Contractors' Equipment Co., 1222-23 Vol Street, Life Building, Chattanooga, Tenn. Bulletin illustrating construction and equipment of asphalt cement tanks fitted with steam chamber and steam core to maintain material at working temperature. Capacities of tanks suited to requirements of job and to promote saving of time, fuel, work and material, also manufacturers of plain tanks for storage of fuel oil.

POWER DRIVEN TRIPLEX PUMPS

240. C. H. & E. Manufacturing Co., Milwaukee, Wis. Illustrated bulletin describing single indelivering large quantities of water a long distance under pressure for road making purposes. Duplicate pumps installed on steel trucks afford portability and reserve for accident.

AN EFFIECIENT HOLT TRACTOR

241. Heil Company, Milwaukee, Wis. tor, used by Lane & Maloney, to serve a large Russell Grader has been operated 10 hours a day for 90 days without any expense for repairs and from August 25th to September 25th moved 29,975 yards of dirt at the same time that 18 mules averaged about 1,000 yards of dirt per month.

COST OF TRACTOR SERVICE FOR ROAD GRADING

242. Atlas Valve Co., 282 South St., Threshing Machine Co. were satisfactorily used on road grading contracts by W. A. Kettlewell, Iowa City, Iowa, who writes that in very light sand the tractor loaded a Maney wheeler with a

MANHOLE COVERS

243. Wm. Dee Co., 30 No. LaSalle St., Chicago, Catalog No. 8, 3½ x 6¼ in., 32 pages. Chiefly descriptive of standard manhole castings and covers, gratings, gutter passages, inlets, liner plates and grate bars. Also notice of Harvey motor trucks.

ROAD REPAIR OUTFITS

244. H. P. Andressen & Co., 1261 No. Clark St., Chicago, Ill. Description of a complete portable outfit for economical and effective road maintenance, designed for quick and complete repair of asphalt, bituminousu concrete, cement concrete, brick, or waterbound and asphalt macadam pavement, providing all materials, tools and equipment in a single outfit.

IRON AND WIRE WORKS

245. E. T. Barnum Iron & Wire Works, Detroit, Mich. Catalog 570, 7 x 10-inch, 66 pages, illustrated.

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Advance Contract News

ADVANCE INFORMATION ITEMIZED PRICES

To be of value this matter must be printed in the number immediately following its receipt, which makes it impossible for us to verify it all. Our sources of information are believed to be reliable, but we cannot guarantee the correctness of all items. Parties in charge of proposed work are requested to send us information concerning it as early as possible; also correction of any errors discovered.

BIDS ASKED FOR

STREETS AND ROADS

Ala., Anniston **Jan. 3**
For 25,000 sq. yds., st. pav., 26,000 lin, ft. curb and gutter—Robert L. Totten, Engr., Birmingham, Ala.

Cal., Los Angeles **9 a.m. Dec. 28**
For const. cement walks,—Bd. Education.

Fla., Lake Wales **2 p.m. Jan. 31**
For 175,000 sq. yds. st. paving.—M. M. Ebert, Town Clk.

Ind., Hammond **Dec. 30**
For grad. and pav. certain sts.,—Bd. Pub. Wks.

Ind., Algona **2 p.m., Jan. 16**
For Geo. Maxton hwy. impv., 29,784 ft. grad., drain and pav.—Frank C. Watkins, Steuben Co. Aud.

Ind., Anderson **10 a.m., Jan. 16**
For Cassellman L. Bruce, Henry Oamp, Chas. P. Cather, Harry O'Connor and David B. Cole rds.—Henry P. Hardie, Co., Aud.

Ind., Indianapolis **10 a.m., Jan. 2**
For grad. and pav. certain sts.—Bd. Pub. Wks.

Ind., Marion Co. **10 a.m., Jan. 26**
For const. part of Churchman Pike, and conc. rd. on Worthwestern Ave.—Leo K. Fesler, Co. Aud.

Ind., Petersburg **Jan. 2**
For pav., gravel and stone surf. various rds.,—W. F. Risley, Co. Aud.

Ia., Hampton **1:30 a.m., Dec. 30**
For gravel surf. approx. 4.10 mi. rd. —Co. Aud.

Kans., Hiawatha **Jan. 5**
For grad. and culverts on Capitol hwy., xx 6.756 mi.,—E. C. L. Wagner, Kemper Bldg., Kansas City, Mo.

Mich., Gladwin **10 a. m., Jan. 6**
For shaping rd., const. drain. structures and surf. with gravel 5.516 mi. rd.—Frank R. Rogers, St. Hgwy. Comr.

Mich., Howell **1:30 p.m., Jan. 3**
For shaping rd. and const. drain. structures on 0.530 mi. rd.—Frank F. Rogers, St. Hgwy. Comr.

Mich., Jackson **1:30 p.m., Jan. 5**
For shap. rd., constr. drain structures and ruf. with gravel 4.646 mi. rd.—Frank F. Rogers, St. Hgwy Comr.

N. Y. Albany **1 p.m., Jan. 10**
For impv. about 45 mi. hgwy. in various counties—Herbert S. Sisson, St. Hgwy Comr.

Tex., Georgetown **11 a.m., Jan. 10**
For clear., grub., grad., drain. structures and surf., abt. 7.5 mi. Florence rd.—H. A. Hodges, Co. Aud.

Tex., Jasper **2:30 p.m., Jan. 10**
For const. 11.1 mi. rd. on St. Hgwy. 3—C. P. Hunter, Co. Engr.

Wis., Madison **11 a. m., Jan. 12**
For grad. and surf. east and west approaches to Sauk City bridge—Wis. Hgwy Comr.

SEWERAGE

Ill., Downers Grove **7:30 p.m. Jan. 7**
For sewage disposal plant, etc.,—Bd. Trustees, San Dist.

Mich., Detroit **11 a.m., Dec. 30,**
For const. sewer and manholes—Jos. A. Martin, Comr., Dept. Pub. Wks.

N. Y., Buffalo **11 a.m. Dec. 27**
For const. 10-in tile sewer,—Dept. Pub. Wks.

WATER SUPPLY

Cal., Los Angeles **3 p.m. Dec. 27**
For cast iron fittings,—Dept. Pub. Serv.

Ga., Atlanta **2:30 p.m. Jan. 31**
For const. filter plant and clear water reservoir,—J. N. Landers, Purchasing Agt.

La., Abbeville **Jan. 5**
For impr. water works and elec. lighting system, install. pumps, water line material, well-working equipment, reservoir, etc.,—Henry A. Mentz, Mgr., Magnolia, Miss.

N. Y., Central Islip **Jan. 11**
For artesian well for additional water supply at power plant,—State Hospital Com.

BRIDGES

Ia., Audubon **2 p.m., Jan. 5**
For const. 2 brdiges—Co. Aud.

Ia., Bedford **1:30 p.m., Dec. 30**
For conts. 47 culverts and 4 bridges —Co. Aud.

Ia., Clinton .... 10 a. m., Jan. 19
For const. bridges and culverts on Primary (Rd. Proj. No. 125—Co. Aud.

LIGHTING AND POWER

Cal., Los Angeles **10 a.m. Dec. 27**
For lighting Pacific ave.,—Bd. Pub. Wks.

Ill., Springfield **1 p.m. Dec. 27**
For storage tank and piping in power house,—Supervising Archt., Capitol bldg.

Nebr., Ewing **Feb. 16**
For const. bridge over Elk Horn River,—Geo. E. Johnson, State Engr.

O., Orrville **Jan. 7**
For erection of overhead transmission line—H. D. Hamlin, Clk., Bd. Trustees of Pub. Affairs.

DRAINAGE AND IRRIGATION

Ind., Fort Wayne **1 p.m. Jan. 7**
For const. Salgy ditch, st. Joseph twp.,—Co. Surv.

MISCELLANEOUS

Ala., Mobile **11 a.m. Jan. 20**
For dredge pontoon catamarans with discharge pipe, U. S. Engr. Office.

N. Y., Manhattan **2 p.m., Jan. 5**
For motor trucks—Henry H. Curran —Boro. Pres.

O., Ironton **Dec. 30**
For maintenance of county ditches for 1922—Co. Comrs.

N. J. Newark—Virgilio Spiniello, Orange N. J., awarded contract for Sec. 19 Garfield Wallington-Passaic Inter. sewer, $65,654.

O. Wadsworth—M. Abernathy, Akron O., awarded contract for San. sewer, $2,100.

O. Akron—D. E. Beattie Co., Akron, O., awarded contract for construction sewers, $63,877.

Ont., Toronto **noon Dec. 27**
For sand dryers for asphalt plant, T. L. Church, Chn., Bd. Control.

Was., Tacoma **2 p.m. Dec. 20**
For const. transit shed, pier No. 2, —Port Tacoma.

Contracts Awarded

Ala., Fort Payne—J. P. Dicus, Burgaw, N. C., received contract from State Highway Department, Montgomery, at $159,325.92, to construct 17,758 miles of chert road. J. H. Mayer, Division Engineer, Birmingham.

Ala., Mobile—Hancock Brothers low bidder on building concrete road between Mobile and Chickasaw for Mobile County Commissioners; probably will receive contract. (Federal Aid Project.)

Alabama—State Hy. Dept., Montgomery, grading, briding and surfacing, local chert, 1,758 mi. road between Ft. Payne and Collinsville, De Kalb Co., to J. P. Dicus, Burgaw, N. C. 68,356 cu. yd common excav., $0.26 per cu.yd. 17,834 cu.yd. solid rock excav., $0.80, 45,168 cu.yd. chert. 1 mi. haul, $0.63, 98,604 cu.yd. chert ½ mi. additional haul. $0.175. 182,913 lb. reinforcing, $0.06. etc., total $159)326.

Ark., Little Rock—O. Kochtitzky, England, Ark., low bidder for clearing, grading and dredging work, $80,221.

Cal. Santa Barbara—Santa Barbara

Co., paving 29 mi. Surf-Lompoc Highway, asphaltic concrete, to Fairchild-Gilmore & Wilton Co., Pacific Electric Bldg., Los Angeles, $497,989.

Cal., Santa Barbara—Paving Haley Cota, Soledad and Casitas Sts., 1½ in. asphaltic concrete on 5 in. concrete, to Hunter & Richardson, 525 Haley St., $55,136.

Cal., Los Angeles—Paving with 6 in. concrete, curbing, guttering and sewers in Eaglerock Ave., to Fairchild-Gilmore-Wilton Co., Pacific Bldg., $40,410.

Cal., Fresno—Improving portions of Echo, Elizabeth and Dudley Sts., to Federal Constr. Co., Call Building, San Francisco, 166,418 sq. ft. grading, 142,822 sq.ft. 1½ in. Warrenite surface on 3½ in asphaltic concrete, 5,230 sq.ft. concrete gutter, 15,230 ft. concrete curb. 15,967 sq.ft. cement sidwalks, etc., $53,862; M St. between Kern and San Diego Sts., to Thompson Bros., 1514 H St. 193,118 sq.ft. grading, 180,555 sq.ft. -½ in. Warrenite surface on 5 in. concrete 12,060 sq.ft. concrete gutter, 6,647 lin. ft. concrete curb., etc., $70,144; San Joan St. between Bway. and M St. to California Road and Street Impvt. Co., Bank of Italy Bldg., 68,521 sq.ft. grading, 63,244 sq.ft. 1½ in Warrenite surface on 3½ in. asphaltic concrete, 5,075 sq.ft. concrete gutter and 2,598 lin.ft. concrete curb, $20,135; University and Moroa Aves. and Van Ness Blvd., to California Road and Street Impvt. Co., Bank of Italy Bldg., 105,468 sq.ft. grading, 81,499 sq.ft. 1½ in. Warrenite on 3½ in. asphaltic concrete, 3,291 sq.ft. concrete gutter, 3,878 ft. concrete curb. 6,652 ft. cement sidewalks, etc., $31,936.

Cal., Calexico—Grading and constructing curbs, sidewalks and crosswalks, to L. S. Atkinson, Chapman Bdg., Los Angeles, $269,496.

Fla. Dunedin—Grading, paving, curbing and guttering 1½ mi. Bway., Scotland, Virginia, Douglas, Lowden and Edgewater Sts., 20,500 sq.yd. asphalt block and 19,500 lin.ft. concrete curb. and gutter, to J. G. Yeats, Port Tampa, $68,000.

Ia,. .Forest .City—Winnebago Co., grading and gravel surfacing Sects. A and B, Primary Rd. Project 120, east and west through Thompson, 21,716 cu. yd. excav. and 22,255 cu.yd. gravel to W. Dutton, Boone, 19,404 cu. yd. excav. at $0.32 and 2,312 cu. yd. at $0.35 per cu. yd.; L. H. Marvill, Des Moines, 9,202 cu. yd. gravel, 1 mi. haul, $0.387 per cu. yd, 57,720 units, ½ mi. hual, $0.104, 17,160 cu. yd. 1 mi. haul, $0.38, 84,240 units ½ mi. haul, $0.10.

Ill., East Moline—Paving various sts., monolithic conc., asphalt or vitr. brk. to V. McLain Constr. Co., 922½ 15th Ave., $107,000.

Ill., Chicago—Bd. Local Impvts., paving 62nd, 61st, Parkside, Major, Massaoit, Menard, Mansfield, Mayfield and Mason Sts., to J. A. McGarry & Co., 189 West Madison St., $233,000.

Illinois—Dept. Pub. Wks. and Buildings. Div. Highways, Springfield, conc. paving 3.89 mi. Route 5, Sect. 6, Du Page Co., to C. C. Stewart & Co., Chicago, $82,760; 5.83 mi. Route 18. Sect. 9, DuPage Co, to A. Ward & Sons, Oak Glen, $124,360; 6.45 mi. Route 18, Sect. 10, DuPage Co., to Cook County, Contg. Co., 115 South Dearborn St., Chicago, $134,951.

Ind., Greenfield—B. D. McColly & Son., Renslaer, Ind., awarded contr. for Parks Crossley gravel Rd., $7,700; Wright & Wickard Rd., to R. P. Const. Co., Lebanon, Ind., $10,709; also C. A. Presnel Gravel Dd., $3,125; I. J. Baity Gravel Rd., $8,274; E. B. Cliff gravel Rd., $9,245; C. R. Milburn gravel Rd., $12,765 and H. E. Wilson Rd. to C. B. Huffmann, Warren Ind., $6,932.

Ind. Clay County—The Commissioners have let the following contracts: Homer Johnson road let to Meneely, Riggs & Brown, of Fontanet, Ind.; Daniel V. Lemay road let to the same bidders, who bid $11,285.99 on the Johnson road and $3,551.81 on the Lemay road. The roads are to be of stone and gravel.

Minnesota—State Hy: Com., St. Paul, paving 23 mi. State Project 27-21, between Morrison Co. Line and Sherburne Co .line, Benton Co., 241,000 s.yd. conc. to McCree, Moos & Co., 711 Merchants Natl. Bank Bldg., St Paul, $544,811.

Minn. St. Paul State Highway Com. awarded contracts as follows:

Trunk Hgwy. No. 18—Brainerd-Nichols, 4 miles gravel surfacing, to Clusian & Lidberg, Grand Rapids.

Trunk Hgwy. No. 18—Elk River-Zimmerman, 9.9 miles gravel surfacing, to Winston Brothers, Minneapolis.

Trunk Hgwy. No. 23—St. Cloud-Foley, 13.6 miles grading; Wilkins & Pettijohn, Park Paids grading, Independent Bridge Co., Minneapolis, bridge, $3,790; Great Northern Bridge Co., Minneapolis, bridge, Morris Construction Co., Morris, mono-culverts, Western Steel Products Co., Duluth, culvert pipe.

Trunk Hgwy. No. 23—Foley-Milaca, 15.6 miles grading; Wilkins & Pettijohn, Park Rapids, grading, Milaca Bridge Co., Milaca, bridge, and mono-culverts, Western Steel Products Co., Duluth, Culvert pipe.

Trunk Hgwy. No. 28—Sauk Center-Westport, 11.8 miles grading; Jurgenson Construction Co., Summit, S. D., grading, Morris Construction Co., Morris, mono-culverts, Klauer Manufacturing Co., Dubuque, Ia., culvert pipe.

Trunk Hgwy. No. 28—Swanville-Sauk Center, 16 miles gravel surfacing, S. Peterson, Minneapolis.

Trunk Hgwy. No. 28—Sauk Center eastward, 2.9 miles gravel surfacing, to Dobbleman & Rasmussen, Minneapolis.

Trunk Hgwy. No. 28—Browns Valley eastward, 23.4 miles gravel surfacing, to Scully and Connelly companies, as above.

Trunk Hgwy. No. 28 — Near Graceville, 4 miles gravel surfacing, to Scully and Connell ycompanies, as above.

Trunk Hgwy. No. 30—Bijou-Waubun, 18 miles gravel surfacing, to Dobbleman & Rasmussen Minneapolis.

Trunk Hgwy. No. 34—Nevis through Akely, 15.4 miles gravel surfacing, to Dobbleman & Rasmussen, Minneapolis, at $18,790.38.

Trunk Hgwy. No. 34—Park Rapids-Nevis, 5.47 miles gravel surfacing, to Willkins & Pettijohn, Park Rapids, Minn.

Trunk Hgwy. No. 35—Bennettsville-Mille Lacs Lake, 8 miles gravel surfacing, to Campbell Equipment Co., Minneapolis.

Trunk Hgwy. No. 35—Aitkin-Bennettsville, 9.8 miles grading: Winston Brothers, Minneapolis, grading, Roach Construction Co., Gaylord, Mono-culverts, Western Steel Products Co., Duluth, culvert pipe.

Trunk Hgwy. No. 35—Grand Rapids-Pokegama Lake, 7.5 miles gravel surfacing, to Day Brothers, Minneapolis.

Trunk Hgwy. No. 54—Elbow Lake-Herman, 12 miles gravel surfacing, to Frank Georgen, Wheaton.

Trunk Hgwy. No. 68—Marshall-Tauton, 17 miles gravel surfacing, to F. C.
Trunk Hgwy. No. 27—St. Cloud-Roy-
Mitchell & Co., Rochester.
alton, Paving, McCree, Moos & Co., St. Paul.

Minn., Wadena—Campbell Const. Co., Minneapolis awarded contr. for paving and curb, $49,719.

Minn., Blue Earth—Contracts awarded as follows: Reader & Gillman, Minneapolis, gravel surf. Div. B. & C.; W. J. Ryan, Blue Earth & E. E. Haight, Winnebago, Minn., Div. A; Guaranteed Gravel & Sand Co., Mankato, Material delivered at Delavan, Minn.

N. Y., Syracuse—Onondago Sidewalk Co. awarded contr. for sidewalk const., on Mariposa St., $691.

N. Y. Syracuse—Guy B. Dickinson awarded contr. for resurf. Burnet Ave, $2,601.

N. Y., Syrncuse—F. J. Baker awarded contr. for resurf. Burnet Ave., $2,601.

N. Y., Syracuse—F. J. Baker, awarded contr. for repairing railroad strip on West Belden Ave., $1,535, and $3,826 respectively.

N. Y., Syracuse—J. H. Gallup awarded contr. for resurf. West Laurel St., $1,034.

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N. Y., Brooklyn—E. Riegelmann, boro pres., Boro Hall, opened bids Dec. 14, paving (1) Bay 28th St., (2) Clara St., (3) Dumont Ave., (4) East 7th St., (5) Lott Ave., (6) Newport St., (7) Rugby Rd., (8) Van Sinderin Ave., (9) West 28th St., (10) 20th Ave., (11) 21st Ave., (12) 48th St., (13) 58th St., (14) 67th St. From 3rd to 4th Aves., (15) 67th St. from Ft. Hamilton Parkway t o 10th Ave., (16) 75th St., (17) 77th St., (18) 78th St., (19) 90th St., repaving, (20) Ridge Blvd., grading sidewalk space, curbing and flagging (21) Division Pl., grading, curbing and laying sidewalks, (22) Van sinderen Ave., (23) 20th Ave., (24) 21st Ave., grading, curbing, laying and relaying sidewalks, (25) 20th Ave., from Borough Asphalt Co., 1301 Metropolitan Ave., (1) $4,522, (2) $7,194, (3) $2,077, (4) $7,635, (5) $2,586, (6) $4,698, (7) $1,452, (8) $5,639, (9) $7,592, (10) $7,060, (11) $6,323, (12) $7,066, (13) $6,055, (14) $6,159, (15) $3,769, (16) $11,519, (17) $6,223, (18) $6,769, (19) $6,344, (20) $26,396.

Missouri—State Hy. Dept. at div. of. Clayton, 7.0625 mi. Le May Ferry Rd., Federal Aid Project 80, St. Louis Co., 45,820 cu.yd. earth and 970 cu.yd. rock excav., 77,664 sq.yd. 1 course concrete pavement and 537.3 cu.yd. concrete masonry, etc, to Unit Constr. Co., Title Guaranty Bldg., St. Louis, $243,981; 6.07 mi. Gravois Rd., Federal Aid Project 78, St. Louis Co., 31,737 cu.yd. earth excav., 71,025 sq.yd. 1 course concrete pavement, 191.6 cu.yd. concrete masonry, etc., to Whitlow Constr. Co., Chas. City, Ia., $199,002

Missouri—State Hy. Dept. at div. office Bloomfield, 8,976 mi. road from Poplar Bluff to Cairo, Federal Aid Project 179, Stoddard Co., to N. Davis, Sikeston, 59,-811.

North Carolina—State Hy. Comm., Raleigh, grading and topeka paving on 5 in. conc. 10.59 mi. State Project 639, Iredell Co., to R. M. Hudson Co., Salisbury, $332,534, 8.84 mi. State Project 653, Mecklneburg Co., and 10.85 mi. State Project 622, Catawba Co., to Union Paving Co., 30th and Locusts Sts., Phila., $269,941 and $322,110 respectively; grading and concrete paving 1.57 mi. State Project. 655, Mecklenburg Co., to Speed-Parker Co., Norton Bldg., Louisville, Ky., $50,954, rein-con. culverts on above to Luten Bridge Co., 405 East 4th Ave., Knoxville, Tenn., $6,950; clearing and grading, 9.87 mi. State Project 456, Orange Co., to Crawford & Crawford, Mebane, $17,743, rein. con. bridges and culverts on above to N. L. Teer, Durham, $16,610; grading, rein. con. culverts and paving 6 in. concrete, 8.5 mi. State Project 632, Gaston Co., to Davis-Wilcox Constr. Co., Spencerville, O., $265,335.

N. C. Marion—McDowell Co., clearing, grading, etc., 7½ mi. road between Stone Mountain Church and Henderson Co. line. to Michaux Constr. Co., Albemarie, $44,878.

N. J., Morristown—Morris Co. grading road from Long Valley to Washington Twp., 25,861 cu.yd. excav., etc., to Gray Constr. Co., Franklin St., $33,-585

N. Y., New York—H. H. Curran, pres. Manhattan Boro., Municipal Bldg., repaving 52nd St., etc., to J. E. Gaffney, 438 East 91st St., $5,255; 76th St., etc., to Asphalt Constr. Co., 2197 Madison Ave., $32,098; curbing, recurbing, flagging, reflagging and paving Fairview Ave., etc., to P. J. Kearns Contg. Co., 2306 Creston Ave., $25,758; grading, curbing and flagging West 187th St., to M. Del Balso, 660 East 221st St., $67,-988.

N. Y., Brooklyn—E. Riegelmann, boro pres., Boro. Hall, repaving Nevins St., etc., to Leonard Paving Co., 233 Bway, New York, $7,949; Ridge Blvd, etc., to Brooklyn Alcatraz Asphalt Co., 407 Hamilton Ave., $31,346; Tillary St., etc., to R. J. Donovan, 618 Union St., $11,-420.

N. Y., New York—H. H. Curran, pres. Manhattan Boro., Municipal Bldg., widening and repaving 60th St. and repaving 69th St., etc., to Interboro Asphalt Co., 2306 Creston Ave., $12,702 and $11,-

814 respectively; repaving East 61st, East 52nd and East 76th Sts., to J. E. Gaffney, 438 East 91st St., $10,384, $23,450 and $6,091 respectively; Bleeker St. etc., to Brusstar Constr. Co., Inc., Harlem River and 150th St., $3,603.

O. Alliance—C. S. Beiry, Alliance O. awarded contr. grading, $2,134.

O., Baker—Copenhagen Bro., Portland, Ore., awarded contr. forf const. 13.2 mi. of grading bridge section, $107,692.

Pa., Mantua—Empire Const. Co., Phila. Pa., awarded contr. for conc. hgwy. $90,844.

Pa., Harrisburg—Ferguson & Wagner, Harrisburg, awarded conctr. for grading and paving North St.

Pa., Harrisburg—Stucker Bros., Const. Co., Harrisburg awarded contr. for laying out, grading and constr. new driveways.

Pa., Philadelphia—Mack Paving & Constr. Co., awarded contr. repairing Amber St., $10,900.

Pa., Philadelphia—Barber Asphalt Paving Co., awarded contract repairing Moutrose St., $2,800, Sixty-sixth St.; $7,100; Jefferson St., $3,000.

Pa., Philadelphia—George F. Dobbin awarded contr. grading and installing underdrainage system, $3,600.

Tex., Rock Springs—Edwards Co. grading 4 mi. Highway 4, 27 acres clearing, 8,981 cu.yd. roadway and 6,944 cu.yd. solid rock excav., 118.5 cu.yd. conc dips, 120 cu.yd. conc., 4,618 lb. reinforcing, to Tibbetts Constr. Co., Box 179, Mineral Wells, $28,916.

Tex., Cuero—DeWitt Co. opened bids Dec. 12 grading and gravel surfacing 10.31 mi. State Highway 39, Federal Aid Project 114, 34,824 cu.yd. borrow, 37,752 cu.yd. earth and 1,400 cu.yd. loose rock excav., 1,021.4 cu.yd. conc., 113,536 lb. reinforcing, 23,718 cu.yd. gravel surfacing to be furnished by county from Stahl, McElroy and Tom, Gonzales, $63,676; W. T. Hutto & Sons, Gonzales, $64,139; Miller Constr. Co., Port Lavaca $69,825.

Wash., Olympia—Hans Peterson Const. Co., 303 Alaska Bldg., Seattle Wash., lowest bidder for North Bank Hgwy, Cooks to Underwood, 3.09 mi., $2,850.

Wash., Olympia—Frank Morgan, Buckley, Wash., awarded contr. for Navy Yard Hgwy. Tidewater to Charleston, 2. 94 mi. $79,584.

Wash., Olympia—Reinseth & Co., 1917, Oakes Ave., Everett awarded contr. for Olympia Hgwy, Beaver to Forks, 9.07 min. $70,752.

Wash., Olympia—Pentille & Pellervo, Naselle Wash., awarded contr. for Ocean Beach Hgwy, Naselle to Johnson's Landing, $26,138.

..**Wash., Olympia**—Boyle H. Linsey, Stevenson, Wash., awarded contr. for North Bank Hgwy, Stevenson, West. $3,827.

Wis., Madison—W. E. Ule, Stevens Point awarded contr. for Pehtigo, Marinette Rd., grading and draining and surf. conc., $110,006.

West Va., Charleston—State Comr. awards contracts as follows:

Greenbrier county. Crawley, Clintonville road, three miles, Joe Carola, Ronceverte, $21,260.

Boone county: Danville, Peytona road, four and six-tenths miles, L. J. Chandler Co., Virgilinia, Va., $71,034.

Monongalia county: Morgantown-Point Marion road, five miles, Keeley Construction Co., Clarksburg, $68,998.71.

Jackson county: Ripley-Fairplain road, two miles, Keeley Construction Co., Clarksburg, $62,516.94.

Marshall county: Moundsville, Taylor's Ridge road, two miles, Stringer & Springer, Moundsville, $42,000.76.

Calhoun county: Grantsville-Arnoldsburg road, three miles, Cavin & Powers, Charleston, $43,825.63.

Grant county: Pendleton county line to Pansy road, four and four-tenths miles, M. N. Shilesly, Johnstown, Pa., $41,220.05.

Morgan county: Berkeley Springs-Hancock road, three and three-tenths miles, Souder Construction Co., Lancaster, Pa., $86,279.10.

Cabell and Wayne counties: Huntington,Hodges Creek road, four and five-tenths miles, Keeley Construction Co., Clarksburg, $129,962.

SEWERAGE AND SANITATION

Kans., Emporia—C. H. Everett, Hutchinson, Kan., awarded contract for 6,950 ft. laterial sewer and 16 manholes, $9,237.

Mass. Boston—D. Vitiello 45 Clement ave. W. Roxbury awarded contract for sewer in W. Roxbury, $3,394.

Mass. Boston—A. Cefelo, 316 Belgrade ave. W. Roxbury awarded contract for sewerage works, $2,379.

Minn. St. Paul—Feyen Construction Co. awarded contract for construction sewer in Clifton St.

1 EXPANSION 2 JOINT 3

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1. Type A-A—Fibre centre non-oozing joint (Solid crown and sides).
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For concrete Roads—Granite, Brick and Wood-block Paving Buildings—Bridges—Walls and Reservoirs.

Samples and Prices on Request.

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Work Contemplated

STREETS & ROADS

Ariz., Kingman—Work is to be completed on 17 mile hill, Kingman-Oatman Highway. Estimated cost $45,000, Federal Government to furnish approximately $1.40 to $1 of county funds.

Ala., Birmingham—We are advised that Mr. W. E. Dickson, Commr. of Public Works, has asked the City Council for authority to purchase five dump trucks, one road roller with a scarifier attachment and one tractor.

Calif., San Francisco—Board of Public Works will call for bids for the improvement of streets in the Mission Terrace Tract, Sunnyside Section, San Francisco. Approximate cost, $100,000.

Calif., Marysville—The electorate of Marysville will vote on a bond issue of $80,000 for paving of street intersections and street improvement adjacent to the school properties and public parks or squares and a bond issue of $50,000 for improvement of Ellis Lake by removing the detritus therefrom.

Col., Richmond—Plans prepared for asphalt concrete surface and constructing cement sidewalks on Ohio St.

Cal., San Luis Obispo—Co. will call bids in January grading paving Ontario House-Aliva Rd.

Col., Denver—Plan paving 12 blocks alley paving Dist. 68, $30,850, 12 blks., 67, $20,621, both 16 and 20 ft. conc.

Fla., Jacksonville—Plans and specifications for surfacing Kings Road, a distance of about 4 miles, and constructing new bridge over Six Mile Creek, were adopted by Board of County Commrs. Surfacing of Edgewood Ave. is also proposed.

Fla., Fort Meade—This city contemplates street paving and the installation of an electric plant and "white way." Nat J. Patterson, Mayor.

Ia., Clarindo—Bids will be called for about January 15 by Gladys Heffin, City Clerk, for 38,000 sq. yd. paving. Henry Traxler, Engr.

Ind., Indianapolis—The State Highway Commission contemplates letting contract for from 100 to 125 miles highway, principally of hard surface type.

Ill., Joliet—Will County is assured that Lincoln Highway and Kankakee-Joliet road will be built soon and the Bluff road to Chicago may be completed. Federal aid of $3,246,281 appropriated.

Ill., Joliet—Grundy County Board of Supervisors adopted resolutions for improving macadam road 1 1-2 miles from end of state aid road in Wauponsee to south en dof river bridge, and for improvement of road east from Charles Woods' corner to Carbon Hill.

Ill., Chicago—The Rogers Park-Clark St. Business Men's Association, headed hy Lyle D. Read, 1725 Jarvis Ave., Chicago, contemplates the installation of street lights between Farwell Ave. and Kenilworth Ave.

Ill., Joliet—Council approved a resolution to pave Center St. Estimated cost, $53,084.

Ill., Rockford—Will pave 40 miles streets brick and macadam, $120,000.

Ill., Waukegan—Plans being prepared to pave streets.

Ill., La Grange—Plans prepared for street paving in various streets. Edwin Hancock, 2047 Ogden Ave., Engrs.

Ill., Durand—Plans being prepared for paving. A. R. Carter, Rockford, Ill., Engr.

Ill., Rockford—Contemplated paving and resurfacing streets. B. C. Harvey, Engr.

Ia., North English—Village will build sewerage system at approximate cost of $30,000. H. R. Green, Cedar Rapids Savings Bank Bldg., Cedar Rapids, Iowa, engr.

Ill., Mt. Vernon—It is planned to

build 27,003 ft. intercepting sewers, settling tank, trickling filter, sludge bed and water supply. $180,000. A. C. Stanfield, city engineer.

Ill., Maconet—Plans being prepared for narrow gauge railroad. W. B. Holmes Stree, Engr.

Ind. Shelbyville—Bids being called about Jan. 4, for imp. of two rds.

Ind., Indianapolis—Board of Public Works adopted a resolution for paving 27th St.

Mass., New Bedford—Construction of three new sewers has been recommended.

Mont., Boseman—Bids were rejected by C. A. Spieth, City Clerk, Dec. 8th, and will be readvertised within the next six months for construction of conc. curbs and segments, sanitary sewer and paving.

Mo., Wheaton—Estimates of the cost for improving highway in Barry County near Wheaton will be prepared by H. P. Mobberty of Springfield, Division State Highway Engr., and have been forwarded to Missouri Highway Commission for approval. Bids will be asked for soon.

Mich., Mackinac Island — City of Mackinac Island voted to pave Main St. the coming summer and it is planned to improve the entrance to the city from the lake by removing old buildings around the docks and paving the runway to the docks. H. George D. Nutting, Consulting Engr., Grand Rapids, Mich.

Mo., Kansas City—Plans paving 59th St. to Meyer Boulevard.

Mo., St. Joseph—Plans prepared for paving $12,144.

Mo., Neosho—Bids for road work in Newton Co., Mo. Co. Ck., Neosho Co.

Mo., Versailles—Installation of sewer system is contemplated.

Mo., Jackson—Plans are being drawn up for sanitary sewerage system. About $100,000.

Mich. Detroit—Plans indeming and paving 1,000 ft. Madison Ave., sheet aspl. 8 in. conc., $35,000.

Minn., Northfield—Construction of sanitary and storm sewers is planned.

N. C., Littleton—Installation of sewerage system and improvement of various streets are planned. About $75,000. H. C. Smith, clerk.

N. J., Jersey City—Plans have been prepared for Fisk St. system, 13,400 lin. ft. 18-24 inch vitr., 4,255 lin. ft. 30-102 inch segment block, 50 lin. ft. 8 ft. 6-inch concrete and 97 lin. ft. 8 ft. 6-inch steel pipe, etc. $203,000. C. A. Van Keuren, City Hall, city engr.

N. J., Trenton—Contemplate paving four streets.

N. J., Atlantic City—Contemplate paving in Atlantic Co. A. H. Nelson, Engr., Guarantee Trust Bldg.

N. J., Burlington—City contemplates sidewalks and curbs.

N. J., Camden—Plans paving various streets and roads, $750,000. J. J. Alberston, Engr.

N. C. Graham—Alamance Co., plans grading and surf. 5. 93 mi., Kimesville Rd., $25,000. W. L. Spoon, Burlington, Engr.

Nebr., Lincoln—Bids were rejected by Dept. of Public Works, 4th floor, Brownell Blk., for construction of gravel surfacing and culverts on Kearney-Simon project, and for constructing ditch checks on Table Rock-Lewiston project. Also gravel surfacing on Overton-Cozad project.

N. Y., North Tonawanda—According to Supervisor Herman A. Gardei plans are being prepared for the construction of pavement on River Road, by state and county.

N. Y., New York—The Cohasset Realty Co. plans the development of property in Queens, known as Buckingham Park. The property and improvements, consisting of the opening of streets and laying of sidewalks, involves an expenditure of $150,000.

N. Mex., Las Cruces—Petition submitted to town board of trustees asking for the paving of 16 blocks in the business district of the city.

N. J., Trenton—Co-operation in paving South Broad St. is pledged by Trenton & Mercer County Traction Co.

N. C., Marion—Improvement and construction of roads is planned for McDowell County. County Commrs. sold $150,000 worth of bonds.

N. J., Burlington—Board of Freeholders, Burlington County, will readvertise for bids for the construction of bituminous asphalt paving.

O, Shaker Heights—Plans prepared for sidewalk const., $12,000.

O. Wapakoneta—Contemplates paving in Noble Mountains Imp., $15,000.

O. Findlay—Contemplate paving to cost, $70,000. Phil. Ballard, Engr.

O, Dayton—A. W. Smith, Vernon Ave., plans to constr. streets, sewers, and lay water mains in 70 acre track. Engr. not selected.

O., Youngstown—Ordinance amending the franchise permitting Ohio Telephone & Telegraph Co. the right to place its toll lines under ground was passed under suspension of rules by council. Ordinances were also passed for paving Broad alley, Point View Ave., and repaving Basin St.,; for constructing sewer on Springdale Ave. Resolutions were passed for constructing sidewalks on west side of South Ave., on Smithfield St., on McCartney Road and on McGuffey St. Also for paving Mormion Ave., repaving Mahoning Ave., grading Sunshine Ave., paving Philadelphia Ave., Clarencedale Ave., sewer Connecticut Ave., paving Neilson Ave.

O., Akron—State board of health is considering demand of residents of Boston township that Akron be ordered to construct new $2,500,000 sewage disposal plant.

Okla., Wilson—City will expend $120,000 for improving sewer, water and electric light systems, etc.

Tex., Amarillo—It is intended to expend sum of $60,000 for extension to sanitary sewer system. The Mayor.

O., Delphos—Allen County Commrs. sold $100,000 in road bonds, insuring improvement of Harding Highway.

O., Columbus—State Highway Dept. considers the widening and repaving of Kinsman Road.

O., Cleveland—The 1922 state highway program at Columbus calls for reconstruction of Lake Road, for which $194,000 was appropriated; Brecksville Road will be widened; Akron Road will be widened and improved. Leon C. Herrick, State Highway Commr.

O., Hamilton—County Commrs. have authorized the County Surveyor to prepare an estimate of the cost of constructing Riverside drive.

Okla., Poteau—A proposed bond issue of $800,000 for construction of highways in Leflore County was sold by County Commissioners.

Pa., Philadelphia—The widening of Streets in downtown district is contemplated in this city.

Tex., Linden—Plans approved for two highways in Cass Co., gravel surf.

Tex., Littlefield—Plans being prepared for State Hgwy. No. 28, $75,000. Gravel surf.

Tex., Big Springs—Plan co. hgwy. in Howard Co., gravel surf and conc., $30,000.

Tex., Beeville—Fed. aid granted for hgwy. in Bee Co., $120,000.

Tex., Cuero—Plans approved for road in De Witt Co., $75,000.

Tex., Georgetown—Plan roads in Willson Co., gravel bid $40,634; Rd. No. 36 B. $41,000.

Tex., Brenham—Will soon call bids paving 26,960 sq. yds., in six streets, $50,000.

Tex., Greeville—Plans being prepared for surf. 12.5 mi. hgwy. 42, crushed stone, $176,494.

Tex., Mason—Plans grading and surf. 14.2 mi. state hgwy. 9, $63,500.

Tex., Pittsburg—Camp Co. preparing plans grading, gravel surf., and building structure 11ml., state hgwy., $128,432.

Tex., Rock Springs—Preparing plans grading 8 mi. rock surf. 2 mi., constr. bridges and culverts on state hgwy., $74,000.

Tex., San Angelo—$150,000 bonds voted for paving Main Sts.

Tex., Sherman—Plans being prepared grading surf. and building structures on 5.54 mi. state hgwy.

Tex., Greenville—This city plans a $1,000,000 street improvement program.

Tex., Waco—Action taken by County Commrs. of Limestone County will result in securing Federal and State Aid to the extent of $90,000, providing for a good road from Waco to Mexia.

Tex., Midlothian—County Commr. L. O. Moore reported the sale of $65,000 road bonds for work on Dallas-Midlothian Road.

Tex., Houston—Liberty County will vote in January on a bond issue of $2,000,000 for the improvement of roads.

Tex., Dallas—Dallas County Commrs. Court authorized County Auditor to advertise for bids for construction of 4 roads to cost $1,509,381.

Tex., Amarillo—Potter County will receive about $9,000 for building asphalt roads into Amarillo. State and Federal aid for road building in various Panhandle counties totals $20,000.

Tex., Brenham—City sold street paving bonds of 40,000 and work will start soon .

Tex., Dallas—Bids on the construction of 2 miles East Pike will be asked by Commr. Jim Miller.

Tex., Robstown—City will vote on a bond issue of $80,000 to provide for paving and graveling about 15 blocks of city streets; also for installing a modern sewerage system and disposal plant. E. E. Sands, of Houston, Engr.

Utah, Salt Lake—Bids were rejected by W. A. Leatham, City Recorder, for construction of curb and gutter.

Utah, Ogden—Preliminary survey of a proposed route from Winder, Utah, south along the rim of Bryce Canyon to an intersection with proposed Panguitch-Kanab state highway has been completed by Preston Linford of the U. S. bureau of public roads. Definite action on proposed improvements will be taken in the near future.

Va., Richmond—Joint ownership and operation of a Portland cement plant to supply the needs of Virginia and surrounding state is recommended by the State Highway Commission.

Wash., Yakima—County Commrs. of Yakima County will soon award a contract for completion of a first class gravel surface on 2 1-2 miles Evergreen Highway.

Wash., Walla Walla—It is proposed to pave highway from Pendleton through Walla Walla to the Columbia County line, a total of 65 miles, to cost $250,000. Citizens will vote in January to match $125,000 Federal aid money.

Wash., Seattle—Council approved plans for grading and water mains on 39th Ave. N.

Wash., Prosser—Two new highway projects are soon to be constructed in the district tributary to Prosser, as follows: A bridge across the Yakima River near Gibbon and new road of 2 miles.

Wash., Chehalis—Lewis County Commissioners authorized an appropriation of $50,000 for paving Ocean Beach Highway, 4.5 miles west of Chehalis.

Wis., Manitowoc—Bids will soon be asked for street flusher, loader and truck. A. H. Zander, City Clerk.

Wis., Green Bay—Plans paving grading and curbing 1.1 mi. Elmore, Cass and Oakland Counties.

Wis., Tomahawk—Contemplate Spirit Falls Rd., $5,000.

Wis., Merrill—Contemplate Rd. const. $5,000. Will mature in Spring.

Wis., Sheboyan—(Revised) County board of Sheboyan county appropriated $70,000 for the purchase of road machinery for 1922, including two large graders and two gravel plant outfits. G. W. Ubbelohde, Sheboyan, Commissioner.

Wis., Sheboyan—County board of Sheboyan county appropriated $30,450 for county aid bridge work in 1922. G. W. Ubbelohde, Sheboyan, Commissioner.

Wis., Sheboygan—County board of Sheboyan appropriated $95,659.38 for gang maintenance work during 1922. G. W. Ubbelohde, Sheboyan, Commissioner.

Wis., Sheboyan—County board of Sheboygan county appropriated $37,-

261.74 for a state and county road construction program for 1922. G. W. Uoelohde, Sheboygan, Commissioner.

Wisconsin—Wisconsin Hy. Comm., Madison, Peshtigo-Marinette Rd., Federal Aid Project 259, Marinette Co., (a) 47,192 sq.yd. concrete surfacing, (b) 15,350 bbl. cement, from W. E. Ule, Stevens Point, (a) $1.52, (b) $2.50, etc., total $108,088; Brogan, Burns & Schaefer, Green Bay (a) $1.29, (b) $3, etc., total $109,714; Jorgenson Constr. Co., Denmark, (a) $1.54, (b) $2.54, etc., total $113,585.

West Virginia—State Rd. Comn., Charleston, to Keeley Constr. Co., Clarksburg, grading 5 mi. Morgantown-Pt. Marion Rd., Monongalia Co., etc., $48,999, grading and paving 2 mi. Ripley-Fairplain Rd., Jackson Co., 10,-27,800 lin.ft. clearing, 55,000 cu.yd. ex. 450 lin.ft. clearing, 13,230 cu.yd. excav., 3,723 cu.yd. plain conc. pave., etc., $62,-517, 4.5 mi. Huntington-Hodges Rd., Cabell and Wayne Counties, 9,400 lin. ft. clearing, 23,300 cu.yd. excav., 8,550 cu.yd. one course plain concrete pavement, etc., $129,852; to L. J. Chandler, Virginia, Va., grading 4 mi. Huntersville-Knapps Creek Rd., Pocahontas Co., $43,200 cu.yd. excav., etc.; $36,713, 4.6 mi. Dawdy Mountain Rd., Boone Co., 102,200 cu.yd. excav., 1,150 cu. yd. dry excav., etc., $71,034; to J. Carola, Ronceverte, grading 3 mi. road from end Project 77 to Clintonville Rd., Greenbrier Co., 22,200 cu.yd. excav., 140 cu.yd. dry ecxav., etc., $21,260; to Stringer & Springer, Moundsville, grading and paving 2 mi. Moundsville-Taylors Ridge Rr., Marshall Co., 10,350 lin.ft. clearing, 15,776 cu.yd. excav., 18,-400 sq.yd. waterbound macadam, etc., $42,001; to Souder Constr. Co., Woolworth Bldg., Lancaster, Pa., grading and paving 3.3 mi. road from Hancock, Md., to Berkerley Springs Rd., Morgan Co., 17,600 lin.ft. clearing, 15,000 cu.yd. excav., 4,550 cu.yd. one course concrete pavement, etc., $86,279; to M. N. Schilsely, Johnstown, Pa., grading 4.4 mi. road from Pendleton Co. to Panay Rd., Grant Co., 23,300 lin.ft. clearing, 42,000 cu.yd. excav., etc., $41,220; Cavin & Powers, Charleston, grading 3 mi. Grantsville-Arnoldsburg Rd., Calhoun Co., 15,800 lin.ft. clearing, 26,900 cu.yd. excav., etc., $43,826.

BRIDGES

Calif., San Francisco—The War Dept. grnated San Francisco permission to build a bridge across San Francisco Bay south of Hunter's Point.

Ia., Pocahontas—Comrs. Pocahontas Co. plan 100 ft. steel truss span bridge, 18 ft. roadway, two 5 ft. sidewalks. $25,000. A. L. Thornton, Pocahontas, engr.

N. J., Trenton—Freeholders approved plans for the improvement of a bridge on the Cedar Grove Road near Princeton. Bids will be advertised for. Estimated cost, $2,300.

North Carolina—State Hy. Comn., Raleigh, rein-con. bridges and culverts on State Projects 639 and 653, Mecklenburg 405 East 4th Ave., Knoxville, Tenn., $30,325. Noted Nov. 17.

North Carolina—State Hy. Comn., Raleigh, rein-con. bridges and culverts on State Project 980, Macon and Swain Counties. from Southern Dray Co., Ashevile, $28,803, W. T. Moore Concrete Products Co., Andrews $31,822, H. A. Brown, Asheville, $31,841, State Project 155, Martin and Pitt Counties, from P. R. Ashby, Tucker Bldg., Raleigh, $30,287, J. W. Gregory, Danville, Va $30,887, J. P. Dicus, Burgaw, $31,716. Noted Nov. 24 under "Streets and Roads."

O., Kenmore—Summit Co. (Akron) takes bids in summer 535 ft. concrete highway bridge, here. $250,000. G. F. Pfeiffer, Court House, engr.

O., Shadesville—Comrs. Franklin Co., (Columbus), 890 ft. steel bridge, 24 ft., to E. M. Scully, 1431 Eastwood Ave., Columbus, $135,000. Above contract does not include approaches, $60,000.

O., Hamilton—Specifications for the proposed conc. bridge at Cokeotto as part of the extension of North Third St., for which $390,000 in bonds will be issued, have been improved by Miami Conservancy District Board. Plans will be submitted by County Engr. Fred M. Hammerle to County Commissioners.

Pa., Phila.—For bridge on 5th St., From Connor & Ley, 3621 North 5th St., $91,300. Jackson & Co., 119 South 4th. $91,300. Jackson & Co., 119 South 4th St., $98,800, Keystone State Constr. Co., 210 South 13th St., $102,000; bridge on 49th St., rfom T. F. Reilly, 50th St. and City Line Ave., $92,363, O. B. S. Co., 5617 Kingessing Ave., $98,839; bridge over Phila. & Reading R.R., Poplar St., from C. G. Shaffer Co., 224 North 32nd St., $26,729, F. J. Boas, 201 North Broad St., $32,000, Jackson & Co., 119 South 4th St., $36,450.

Pa., Phila.—Delaware River Bridge Comn., Widener Bldg., opened bids Dec. 19, bridge over Delaware River between here and Camden, N. J., (1) additional, for excav. and concrete below cutting edge of Pier A, not below el. 85 ft. $500 cu.yd.); (2) additional for excav. and concrete below cutting edge of Pier B, not below el. 105 ft. (1,100 cu.yd.); etc., from Holbrook (1,100 cu.yd.); etc., from Holbrook, Cabot & Rollins Corp., 52 Vanderbilt Ave., New York, and Keystone State Constr. Co:. 210 South 13th St., (1) $13.50, (2) $20, etc., total $1,669,275; Foundation Co., 120 Liberty St., New York, (1) $65, (2) $75, total $1,843,750; Eyre & Johnson, Phila., (1) $48, (2) $68, total $1,943,744.

Pa., Phila.—F. H. Caven dir. pub. wks., opened bids Dec. 13, removing old w.i. truss spans and piers, and building bridge over Schuylkill River, South St., from Dravo Contg. Co., Real Estate Trust Bldg., $644,000; Keystone State Constr. Co. 210 South 13th St., $721,000; Snare Corp., 1524 Chestnut St., $872,000.

Tex., La Grange—Fayette Co. making plans 1,200 ft. bridge on Highway 3B, over Colorado River, here, to have 300 ft. steel center span, 13 0 ft. concrete arch spans. $302,500. A. Schlafli, Schulenburg, co. engr.

Wisconsin—County appropriations for bridge work during 1922, Adams Co. $3,000. J. A. McGregor, Friendship, comr.; Barron Co. $35,890. E. Geason, Barron, comr.; Buffalo Co. $54,182. J. Reinhardt, Nelson comr.; Chippewa Co. $36,383. P. O. Lokrantz, Chippewa Falls, comr.; Dane Co. $50,000. E. J. Smith, Madison, comr.; Eau Claire Co. $12,000. G. Osborne, Eau Claire, comr.; Grant Co. $47,275. H. Mink, Lancaster, comr.; Jefferson Co. $2,498. R. D. Royce, Ft. Atkinson, comr.; Pepin Co. $7,000. G. A. Goss, Durand, comr.; Pierce Co. $18,400. C. F. Kenall, Ellsworth, comr.; Kewaunee Co. $25,265. M. Shaw, Algoma, comr.; Walworth Co. $5,000. H. J. Peter, Elkhorn, comr.; Wood Co. $21,-888. E. Morris, Wisconsin Rapids, comr.: Monroe Co. $40,207. C. H. Millard, Sparta, comr.; Sauk Co. $38,041. E. H. Groth, Baraboo, comr.; Waukesha Co. $42,100. C. J. Hahn, Waukesha, comr.; Burnett Co. $21,600. G. E. Miller, Antigo, comr.; Brown Co. $25,000. G. J. Cormier, Green Bay, comr.; Calumet Co. $3,600. W. Hoenig, Chilton, comr.; Waupaca Co. $43,100. J. Huffcut, Waupaca, comr.; Waushara Co. $10,000. G. Grimm, Wautoma, comr.; Sawyer Co. $12,000. E. J. Collett, Hayward, comr.; Ashland Co. $12,057. W. E. Dillon, Highbridge, comr.

Ont., Toronto—Plans bridge over ravine on St. Claire Ave., probably steel. $712,000. R. C. Harris, City Hall, comr. pub. wks.

Utah, Ogden—Plans and specifications for construction of Riverdale overhead crossing over Union Pacific tracts south of Ogden are being completed under direction of State Bridge Engineer Eugene Bush. Bids will be asked soon. Entire structure, including viaduct, approaches and 2 steel spans of 135 ft. each estimated at $200,-000.

Fla. Jacksonville—J. A. Kidd, Jacksonville, Fla., awarded contract removing wooden bridge over Six Mile creek and construction new wooden bridge, 2,498.

Pa. Philadelphia—Keystone State Construction Co., Phil and Holbrook, Cabot and Rollins low bidders for construction two main piers Delaware River bridge, $1,669,275. Above firms will be awarded contract in two weeks.

Florence, S. C.—Contracts for the Pee Dee bridge project were let last night to Chitwood & Palmer for approaches, wooden bridges on causeway and roadway, etc., and to Hyde & Baxter for the construction of the steel bridge which will span the river. Contracts total $131,987.

W. Va., Bluefield—McClintic-Marshall Company, Pittsburgh, Pa., awarded contract to construct bridge on Princton-Spanishburg road, $7,600.

MISCELLANEOUS

Ia., Garner—Christianson & Gustavson, Mason City, awarded contract for labor for construction D. D. No. 118, $2,463. Material to Humbolt Gravel & Tile Co. Humbolt, $3,790.

Minn., Jackson—Contracts awarded as follows: D. A. Lahart, Window, Minn., J. D., No. 65, $9,00; Wilson Bros., 609 Globe Bldg., Minneapolis, J. D., No. 76, open work, 9½c per yard; Pete Thompson, Window Minn., Tile work, $106,765; D. A. Lahart, Window, Minn., J. D., No. 83, $9,440; Mathews Bros., Eriee, Ill., open work, 9 cents per cubic yard; Nielsen & Sorenson, Worthington, Minn., Tile work, $38,216.

Va., Norfolk—Fred E. Jones Dredging Co., Norflok, awarded contract dredging at Navy yard, 16 cents.

Tex., Beaumont—Howard Kenyon Dredging Co., Houston, & J. E. Brousard, awarded contract, $1,000,000, drainage project.

SEWERAGE & SANITATION

Fla., Dunedin—For 11,700 ft. sanitary and storm sewers in Bway., Scotland, Virginia, Douglas, Lowden and Edgewater Sts., to J. G. Yeats, Port Tampa, $26,503. Noted Nov. 24 under Streets and Roads.

Fla., West Palm Beach—On December 27 vote will be taken on $100,000 bond issue for storm and sanitary sewers. K. D. Riddle, city engioeer.

Ga., Millen—Lawrence Manning has prepared plans for extending sewer system for city. The mayor.

Ill., Mt. Olive—Bd. Local Impvts., sewers, to J. Keeley Co., Cahokia Bldg., East St. Louis, $82,400.

Mo., Joplin—For 3,500 ft. 8 in. tile sewers between Wall and Pearl Sts., from 23rd to 27th Sts. between Virginia and Pennsylvania Aves. from 23rd to 27th Sts., Harlem and Porter Aves. between B and C Sts., between Harlem and Porter Aves. from 19th to 26th Sts., to E and V. E. Koch, 2304 Pennsylvania Ave., $1.67-$1.72 per lin. ft.

Ia., Clinton—Resolution adopted by council will provide for the construction of sewers in District No. 6.

Kans., Topeka—Harland C. Bartholomew, Topeka, city planner, recommends the improvement of the sewerage system of the city.

Mo., St. Louis—A bill will be submitted to Public Utilities Committee of the Board of Aldermen calling for the establishment of three incineration plants

N. J. Harrison—Passaic Valley Sewerage Comrs., 128 Market St., Newark, to Harrison & Craig, 31 Clinton St., Newark, southerly portion Sect. 28, Kearny-East Newark-Harrison Branch Intercepting Sewer, here, 3,110 lin.ft. earth excav. and refill in trench for 36 in. concrete sefer, $25.75 per lin.fi., 660 lin.ft. earth excav. and refill in trench for 15 in. vitr. sewer, $8.50, 1,560 cu.yd. concrete masonry, $14,50, etc., total, $129,863. Noted Nov. 17.

N. Y., New York—H. Bruckner, pres. Bronx Boro. Municipal Bldg., opened bids Dec. 12, sewers in East Tremont Ave., west side between Appleton and Coddington Aves., etc., from J. L. Sigretto & Co., $50,701; Clemente Contg. Co., 1195 Spofford St., $53,933. Noted Dec. 8.

N. Y., New York—H. H. Curran, pres. Manhattan Boro. Municipal Bldg., opened bids Dec. 12, altering and improving sewer in West 20th St., from J. Burns, 103 East 125th St., $18,355, P. J. Kearns Contg. Co., 2306 Creston Ave., $18,750 T. A. Reilly Co., 48 East 41st St., $21,315; repairing 15 in. vitr. sewer in East 101st St., from J. V. Timoney Co., 220 East 201st St., $2.425, Slatterly Eng. & Constr. Co., 10 East 43rd St., $3,225, P. J. Kearns Contg. Co., 2306 Creston Ave., $3,360. Noted Dec. 8.

N. Y., Brooklyn—E. Riegelman, boro. pres., Boro Hall, storm and sanitary sewers, to Tomasetti & Co., 1133 60th St., in Ave. S. 82.87% of engineers estimate ($28,000) in Fenimore St., etc., 88.98% ($3,000); to Murphy Bros., 8856 26th Ave., in 64th St., etc., 71.34% ($2,000). Noted Dec. 8.

O., Akron—Director Pub. Serv. 1,925 ft. 120 in. vitr. brick and 3,000 ft. 6-12 in. tile sewer in Willow Run Contr. 2, to W. Gibbons Constr. Co., Cleveland, $109,423. Noted Dec. 1.
estimated to cost $180,000.

Minn., Deer River—Citizens are interested in a project for the construction o fa sewer system. Total cost es-

Okla., Ramona — Preliminary plans are being prepared for 3 mile sewerage system and disposal plant. Approximate cost $40,000. V. V. Long & Co., engineers.

Pa., Ellwood City—Construction of sewage disposal plant is planned. About $100,000. A. Main, 228 6th St., boro engineer.

S. C., Marion—On January 17, 1922, vote will be taken on $100,000 bond issue for extending sewer system, constructing white way, etc. The mayor.

LIGHTING & POWER

Ala., Birmingham—Comrs. order 26 street lights installed.

Ala., Montgomery — The Houston Power Co. was granted permission to erect a dam and hydro-electric power plant on the Choctawhatchee River.

Ark., Fayetteville—Frank I. Wilcox, Contr. Engr., Chemical Bldg., St. Louis, Mo., has completed plans for a new steam power water plant, Westfork on White River

Calif., Oroville—City Trustees will call a bond election soon for the proposed municipal electrical distribution system.

Calif., Quincy—William Watson in charge of surveying crew will survey for power line for F. G. Gansner, owner of electric plant, Quincy, to connect with Great Western Power Co. at a point between Indian Falls and Paxton.

Fla., San Juan—Purchase of power planta of Orlando Water & Light Co., delayed by survey for streets and proposed bond issue to include all. $1,500,000.

Fla., Crescent City—Bonds voted for enlargement of municipal electric light plant and water works.

Ind., Frankfort—This city is to have a new electric light and power plant. Estimated cost $250,000, according to C. D. Lyon, consulting engineer, Cincinnati.

Ia., Muscatine—City Council will call special election for vote on bond issue of $250,000 for a municipal electric lighting plant.

Md., Hagerstown — Hagerstown & Frederick Ry. Co. consider the erection of a great power unit at the coal mine at Confluence, Pa.

Mich., Lansing—Council considers the installation of an ornamental lighting system on Ver Linden Ave. and Durant Factory St.

Minn., St. Paul—St. Paul Gas Light Co., ordered to extend its electrical lines.

Nev., Reno — An extension of the "White Way" lighting system in the business district and the addition of 27 more street lights in residence district was recommended to city council.

Okla., Red Rock—A campaign for an electric light plant has been started here.

O., Toledo—Work on the $1,500,00 power belt line to be installed by the Toledo-Edison Co. will start April 1, according to General Manager Fred Derge. Line will be approximately 28 miles in length.

N. J., Trenton—Ordinance passed requiring Trenton Street Railway maintain cable underground on Lincoln Ave.

Northern France — There being no water-power possibilities in the region, efforts are being directed toward the more economical employment of coal with a view to reducing power costs and permitting manufactured articles to be placed on the market at competing prices. Various coal-mining companies in the Department have constructed electric power plants driven by steam, utilizing the unsalable low-grade coal, washings, and slack at the pit mouth. Still others are in process of construction or are contemplated.

Pa., Braddock—City Council plans the installation of a municipal light plant.

Pa., Hazelton — The Pennsylvania Power & Light Co. will install a large number of lights in this city.

Tex., Grosebee—Plans light and sewerage system.

Wis., Racine — A privately owned plant is considered for Kenosha, according to W. A. Gross, chief engineer, Nash Motor Co., Kenosha.

Wis., Madison—The Peninsular Power Co., headquarters Commercial National Bank Bldg., Madison, will build a power house at Crystal Falls, Mich. Estimated cost, $60,000.

WATER SUPPLY

Calif., Placerville — City Trustees voted in favor of the purchase of the high pressure system of the El Dorado Water Co. Thirty Thousand dollars in bonds was voted for water system improvement.

Ga., Milledgeville—City recently acquired water works, which are to be reconstructed. Installation of filtering system is contemplated. J. B. McCrary Engineering Co., engineer.

Ia., Cedar Rapids—To vote on $175,000 bonds for reservoir, 266 ft. diam., rein.-con. walls, flat slab roof. Hatton, Holmes & Anthony, 321 Masonic Temple, engrs. Noted Oct. 13.

Ia., Clinton—Clinton Water Co., 5th Ave. and 1st St., plans 1,000,000 gal. reservoir, elevated steel tank, 4 mi. mains, 2 mi. 24 in. pipe, new pumps, also auxiliary pumping station at Lyons, Ind. $100,000. W. L. Meeker, supt.

Ind. Hammond—J. Erickson, engr., 30 North LaSalle St., Chicago, soon receives bids 1 story, 50 x 5 ft. boiler house and 1 story, 65 x 95 ft. pumping station for city. $75,000. Wolf, Sexton, Harper & Trueax, 19 West Madison St., Chicago, archts.

Ill., Des Plaines — Bd Pub. Wks. making plans 6 in. c.i. mains and 10-12 in. vitr. tile sewers. $27,000. W. H. Allen, 122 South Michigan Ave., Chicago, engr.

Kans., Topeka — City Commission passed an ordinance providing for the issue of the remaining $95,000 waterworks improvement bonds.

N. J. Trenton—State Board of Public Utility Commrs. granted authority to Hackensack Water Co. to issue $2,000,000 bonds. The extension of the plant is contemplated.

N. Y., Binghamton—Request for a new and adequate water supply system at Broome County Farm was made by Supt. A. A. Lord.

Miss., Belzoni — Belzoni D. D. plans pumping plant for reclamation of 4,000 acres. C. E. Miller, Belzoni, engr.

Mo., Mountain Grove — Vote to be taken some time in January on $20,000 bond issue for improving water works plant and paving streets.

O., Akron—Plans addition to purification plant, $80,000; pumping station and buildings, $70,000; pipe line, $350,000. G. G. Dixon, 102 East Mill St., engr.

Mo., Caruthersville — City voted to issue $65,000 bonds for improving and enlarging water works.

Mo., Portageville—City will lay 6-inch cast iron mains, pumps, tank and tower at approximate cost of $40,000. A. C. Moore, Joplin, engineer.

O. Cleveland—Babcock & Wilxox Co., Guardian Bldg., awarded contract for 4 water tube boilers, $91,834.

O. West Park—Sewer & Water Imp. Co., 1350 West 89th St., Cleveland awarded contract for 41,000 ft. 6-8 in. c.c. mains.

Okla., Romona — City will expend $10,000 for water-works extensions. V. V. Long & Co., engineers, 1300 Colcord Bldg., Oklahoma City.

S. C., Walhalla—Voted $90,000 bonds for waterworks. J. Moss, chn. Pub. Wks. Engineer not selected.

S. C., Johnston—City will install water works, for which $65,000 will be issued. The Mayor.

S. C., Kingstree — Installation of water is planned. Lee, Pannell & Murray, 7½ Lorange Street, Sumter, S. C., engineers.

Tex., Galveston—H. L. Durland, consulting engineer, will prepare plans for the installation of an oil engine plant at Alta Loma. Bids will be advertised for. Approximate cost of plant, $117,000.

Tex., Jacksonville — Bonds to the amount of $150,000 for water works improvement were recently voted. T. E. Acker, Mayor.

Va., Richmond—Contracts awarded as follows: stand pipe and foundation to Pittsburgh-Des Moines Steel Co., Tuttle & South West 10th St., Des Moines, Ia., $12,350; e. i. pie to American Cast Iron Pipe Co., 176 Scarret Bldg., Kansas City, Mo., $2,400. Will call bids about Jan. 10th for filteration plant.

Va., Richmond—It is intended to extend water works and enlarge storage facilities. $1,500,000 bond issue approved.

Va., South Boston—Water and sewer systems to be improved and water mains constructed. The Mayor.

Wyo., Greybull—Council will call a special election to vote on water bonds.

Wis., Stevens Point—Feb. 8 to vote on $65,000 bonds, developing new source water supply, incl. sinking wells, pumping station, piping, etc. W. G. Kirchoffer, Vroman Blk., Madison, engineer.

Ont., Ottawa—The Board of Control recommended to the City Council the installation of water mains in the territory bounded by Holland Ave., the City Limits, Spencer St. and Scott St. The estimated cost of the work is $42,325.

Ont., Hamilton — Work upon the James Street reservoir has almost been completed, and wat er will likely be turned into the big tank this week. The concrete work has been finished and drainage system installed.

Sask., Yorkton—City officials consider a gravity water project estimated to cost $50,000 and an additional 550 horsepower unit for electric power house, estimated to cost $75,000.

MISCELLANEOUS

Calif., Los Angeles—Board of Harbor Commrs. have taken steps toward the proposed $1,200,000 project which calls for the building of a terminal island on the east side of the main channel. Plans will be prepared by Harbor Engineer Vincent. Approximate cost $215,000.

Calif., Los Angeles—At a conference between State Highway Commission, United States Forestry Dept., and San Bernardino County Engrs. it was decided to proceed with the construction of Deep Creek cut off. Total cost estimated $205,000.

Calif., Sacramento—Improvements in Butte and Sutter Counties planned by Reclamation Dist. 2,054, will cost approximately $119,470.

D .C., Washington—Improvement of waterway inside the shore line between Chincoteague Bay, Va., and Lewes Del., was recommended by army engineers. Dredging of a channel 6 ft. deep at mean low water and 40 to 50

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For your new road contract you will want pipe for your water service. Our used pipe, rethreaded and coupled, will answer your requirements the same as new pipe and will save you considerable money. We carry all sizes from ¾ to 12 inches, have large stock, 1, 1¼, 1½, 2, 2½, 3 and 4 inches.

Marine Metal & Supply Co.
167 South St., N. Y. City
137-147 Fifteenth St., Jersey City

HELP WANTED

WANTED—Civil Engineer and Superintendent of Streets, in New England town of 30,000. State age, education, experience, references and salary expected. Address Box 373, care Public Works, 243 W. 39th St., New York. (26-27)

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ft. wide, estimated to cost $246,000.

D. C., Washington—An expenditure of approximately $43,000,000 for rivers and harbors in the fiscal year 1923 is recommended by Maj. Gen. Beach, chief of army engineers: $40,000 will be appropriated for the Chicago harbor and $20,000 for the Chicago river.

La., New Orleans—The Jefferson police jury created a new drainage district. Project known as Ames Municipal Dra. Dist. About $100,000 will be expended for construction of ditches and other improvements. Meyer Eiseman, pres.

Mo., St. Joseph—Commrs. contemplate the construction of a drainage ditch at Lake Contrary to cost $100,500 for excavating work, $20,000 for bridges and $10,000 for right of way.

Md., Baltimore—Plans as prepared by Edwin J. Clapp and Francis Lee Stuart, Engrs., for the Port Developement Commission call for the following: Development of piers, McComas St. property, on Mud Islands and flats adjacent to Hanover St. bridge, and on property of Arundel Corp.; acquisition of Mud Islands and flats and Arundel Corp.'s property; development of Hughes St. property as a terminal; turning over of harbor belt line to railroads; building outside belt line; reciprocal switching between Western Maryland and Baltimore & Ohio Railroads; establishing piers.

Calif., Berklye—A total of $1,014,500 was subscribed for building the memorial stadium at University of Calif. Frank H. Probert, Chairman of the Stadium Committee.

Fla., Eustis—City voted in favor of purchasing a fire-engine for the city, cost not to exceed $10,250.

Ill., Granite City—Citizens voted in favor of a bond issue of $30,000 to provide for equipment for fire dept.

Nev., Reno—The Seven Troughs Reorganized Mines Co., L. A. Friedman, Pres., plan the driving of a tunnel at a cost of about $200,000. John G. Huntington, of Reno, engineer for the company.

N. Y., Utica—City officials consider the installation of a new fire alarm system here.

N. Y., Buffalo—According to Frank J. Perkins, members of the City Council, Buffalo will sink test wells for natural gas on city property.

Pa., Philadelphia — Plans are being prepared for the reconstruction of Franklin Field for the University of Pa.

OFFICIAL ADVERTISING

HIGHWAY WORK

OFFICE OF STATE COMMISSION OF HIGHWAYS

Sealed proposals will be received by the undersigned, at their office No. 55 Lancaster Street, Albany, N. Y., at one o'clock P. M. on TUESDAY, the 10th day of JANUARY, 1922, for the improvement of highways in the following counties:

ALBANY—One highway, 5.89.
ALLEGANY—One highway, 5.01.
DUTCHESS—One highway, 1.33
FRANKLIN—One highway, 7.50.
GENESEE—One highway, 2.10.
ORANGE—One highway, 2.75.
ORLEANS—One highway, 2.25.
SCHOHARIE—Two highways, 3.94 & 10.33
SULLIVAN—One highway, 5.69.

Maps, plans, specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany, N. Y., and also at the office of the division engineers in whose division the roads are to be improved. The addresses o fthe division engineers and the counties in which they are in charge will be furnished upon reuest.

The especial attention of bidders is called to "General Information for Bidders" in the itemized proposal, specifications and contract agreement.

HERBERT S. SISSON,
Commissioner.

J. C. FINCH,
Secretary.

27-1

TOO LATE FOR CLASSIFICATION

BIDS ASKED FOR

STREETS AND ROADS

Ill., Cairo **2 p. m., Jan. 16**
For road work—Bd Co. Comrs.

N. J., Bridgeton **2 p. m., Jan. 10**
For const. state hwy. route 6, Bd. Chosen Freeholders, Cumberland co.

O., Celina **Jan. 10**
For 6374 lin ft pipe guard rail, Leon C. Herrick, Dir. State Hwys.

Okla., Idabel **2 p. m., Jan 10**
For sec A, B and C, Fed Aid Proj No. 40—Co. Clk.

Okla., Sayre **Feb. 6**
For paving, $125,000—W. E. Simmonds, City Clk.

Va., Richmond **noon, Jan. 5**
For const. St. Proj. Nos. 154, S-164—G. P. Coleman, St Hwy Comr.

SEWERAGE

S. D., Madison **8 p. m., Jan. 23**
For const. sanitary sewers—Wm. Rae, City Aud.

WATER SUPPLY

Minn., Duluth **11 a. m., Jan20**
For centrifugal pump unit—F. D. Ash, City Clk.

Minn., St. Paul **11.30 a. m., Jan. 9**
For cast iron gate valve and service connection boxes—H. W. Austin, Purchasing Agt.

LIGHTING AND POWER

Minn., St. Paul **11.30 a. m., Jan. 9**
For electrical energy for pumping station—H. W. Austin, Purchasing Agt.

BRIDGES

Kans., Lyons **noon, Jan 23**
For const 2 bridges—Sam Ainesworth, Co. Engr.

W. Va., Charleston **Jan. 15**
For bridge to cost about $40,000 in Hartland—C. P. Fartney, St. Rd. Comr.

MISCELLANEOUS

D. C. Washington **10:30 a.m., Jan. 11**
For meters, meter-sealing wires and rotating meter-testing standards,—Gen. Purchasing Officer, Panama Canal Washington.

Nebr., Omaha **noon Jan. 10**
For ditch checks for co. during 1922, —Frank Dewey, Co. Aud.

Tex., Dallas **10 a.m. Jan. 4**
For automobile for police and fire signal depts.,—M. G James, City Secr'y

STREETS AND ROADS

Ind., Veray—Culberstone Bras Veray awarded contr for constr Hgwy.

Ind., Shoals—Wm. Patterson, Loogootee awarded contr for Hgwy in Perry Trop.

Ind., South Bend—White Constr Co., 10 Merchants Co., awarded contr for widening street.

Ia., Des Moines—Wright Constr Co., 211 Flynn Bldg awarded contr for paving.

Ia., Ames—W. M. Walkmus, Livermore Ia. awarded contr for graveling.

Kans., Atchison—E. P. Olson S. V. Joseph Mo. awarded contr for Fed and Rd—work $31,175.

Md., Baltimore—Baltimore Block & File Co. 320 N. Monroe St. awarded contr paving various streets.

Minn., Blue Earth—Meixner & Arndt awarded contr for curbing.

Minn., Hibbuig—A. Gurhrie & Co., 366 Jackson St., S. V. Paul awarded contr for grading.

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Manufacturers of COMPRESSED AIR FIRE WHISTLES, WHISTLE BLOWERS, BELL STRIKERS, BOXES, GONGS, Etc., Etc.
Estimates Cheerfully Given

Mo., Kirksnille—James G. Reed awarded contr for sidewalk. Const. start in Spring.

Nebr., Paunee City—American Paving Corp. Omaha, awarded contr for paving and sewers $102,152.

N. C., Raleigh—Parters & Boyd, Charlote N. C., awarded contr for road improvement in Wilkes Co.

O., Cashnetun—Henderson Bros. awarded contr for road grading.

O., Alliance—C. S. Biery, Alliance & J. C. Devline Co. Alliance awarded contr for paving and sewer constr.

O., North College Hill—Alzert Krass Mt. Healthy O. awarded contr for macadam grad and drain.

Pa., Minersville—Jos. Newcomb, Spring St. Pittstone, Pa. awarded contr for paving street. $43,500.

W. Va., Charleston—Andy Nicholich, Fairmont W. Va., awarded contr for road grading.

W. Va., Fairmont—F. Y. Harnor Clarksberg, W. Va. awarded contr for road grading.

Charleston, W. Va.—State Highway comr., Clarkston, Court House, let contr. ofr rd. imp. in Mongalia, W. Va., to Keeley Constr. Co., Clarksburg, W. Va. W. S. Downs, div. engr., Morgantown, W. Va. Major Fortney, engr., Charleston, R. Palmer, county engr., Court House, Fairmont, & rd. in Marshall county to Springer & Springer, Moundsville, W. Va., & rd. in Boone county to L. J. Chandelr, Virgliina, Va., & rd. in Jackson county to Keeley Constr. Co., Clarksburg & rd. in Greenbrier county to Joe Carola, Ronceverte, W. Va., & rd in Cabell & Wayne county to Keeley Constr. Co., rd. in Calhoun county to Powers, Charleston, Morgan county to Souder Constr., Lancaster, Pa.

SEWERAGE AND SANITATION

Ind., Richmond—John H. Hipskind awarded contr for constr sewer.

Ind., Noblesville—Nappanee Const. Co. Nappanee Ind. awarded contr for drain.

Ind., Des Moines—G. G. Herrick, 704 Observatory bldg. awarded contr for sewer.

Kans., Augusta—Smith—Graham Const. Co. Augusta Kans. awarded contr constr. sewers. $22,407.

Mo., Columbia—C. J. McCoy Const. Co. Emporia Kan. awarded contr for sewarge disposal plant and san. sewer.

N. J., Passaic—S. Guardalibeni Passaic St. Lode N. J. awarded contr for sau. sewer.

O., Akron—E. L. Brueggeman Akron awarded contr for sewer constr in Summit Co.

O. Akron—Walter P. Gibbons Cmtrg. Co. 343 Superior Arcade Cleveland awarded contr for trunk sewer $170,000.

O., Wadsworth—Abernathy, 1379 Grant St. Akron awarded contr for sewer in Grandrun Ave.

WATER SUPPLY

Mich., Oakwood—Oakwood Const. Co. 165 Ford blvd. awarded contr for water maine extension $20,000.

N. J., Gloucester—Hearner & Guthridge Norristown Pa. awarded contr for water works and pumping stations. $200,000.

O. Cleveland—Otomar Stange & Jack Welch, St Clark & Cleveland O. awarded contr for reservoir.

Okla., Broken Bow—Ladd Constr Co. 716 Ccarritt bldg. Kansas City Mo. awarded contr for water works and sewers.

BRIDGES

Ill., Springfield—D. W. Carnine Sullivan Ill. awarded contr constr Nortle Rd. bridge. $18,738.

Pa., New Castle—Minter & Anderson New Wilmington awarded contr for hgwy bridge,$550,000.

Pa., Philadelphia—T. F. Reilly, 50th and City Aves. awarded contr for foot and trolley bridges.

Va. Richmond—Roanoke Iron Bridge Works Inc. Roanoke awarded contr for bridge over Dry Creek on S. V. Rd No. 10.

W. Va., Sutton—Oregonia Bridge Co. Lebanon O. awarded contr for constr bridge, $225,000.

W. Va., Clay—Oregonia Bridge Co. Lebanon O. awarded contr for constr bridge,$25,000.

WORK CONTEMPLATED

Ill., East Moline—Plans being prepared for paving in 7th St. to mature in Spring. Roy E. Sneary Engr.

Ill., Napesville—Plans prepared for street improvement to mature in Spring. C. A. Ashley Engr.

Ill., Cairo—Bids call for about Jan. 15 for road work.

Ia., Hinsdale—Plans prepared for paving and reinfacing, $45,000.

Ia., Cherokee Co.—Sate Hgwy Amer. contemplates road work.

Ia., Spencer Co.—Conrs contemplate graveling rd in Clay Co. W. C. Mc Cown Engr.

Ia., Storm Lake Co.—Cnurs contemplate graveling Rd in Beuna Vista Co. will mature 1923.

Ia., Spirit Lake Co.—Cover contemplates paving in Dukinsor Co. R. A. Furmane Engr.

Ind., La Parte—Plans prepared for paving Ind. Rushville—Calling bids for highway work in Walker Twp.

STREETS AND ROADS

Ind., English—Plans prepared for highway in Whiskey Rum Twp.

Ind., Corydon—Plans prepared for Pitmaud Rd in Harrison Co. Ind. also Rumley & Roudenbush Rd.

Ind., Rockville—Plans prepared for highway to sost $12,000 in Penn Twp.

Ind., Newpart—Plans prepared for constr hgwy in Vermullen Twp.

Ind., Lebanon—Bd. Covers contemplate constr hgwy $10,800.

Ind., Petersberg—Plans prepared for constr hgwy in Logan Twp.

Ind., Eransville—Plans prepared for constr Hgwy. $21,935.

Ind., Andola—Plans prepared for constr rd. Will call bids about Feb. 1.

Ky., Frankfort—Contemplate constr Rd in Montgomery Co.

Kans., Fort Scott—Plans prepared for constr 2.26 mi bit macadam and 3.16 mi bit macadam 16 ft wide.

Md., Baltimore—City Counsil contemplates proving various alleys $30,000 and repairing streets $1,285.

Mass., Franklin—City contemplates paving $12,000.

Mich. Benton Harbor—Plans submitted for proposed boulevard system and bridge connecting with St. Joseph.

Mo. Kansas City—Plans prepared for grading Elmwood Ave. and establishing grade.

Mont., Broadus—Bids being called for Powder River Co. Rd bonds until Feb. 8.

N. J., Millwood Crest—Plans being prepared to constr sidewalk and curbs in Atlantic Ave.

N. J., Bridgeton—Plans being prepared for road paving in Cumberland Co. $350,000.

N. J., Millville—City contemplates street paving and sewer constr. $15,000. N. R. Wade, Engr.

O. Columbus—Co. Contemplates road imp. in Darke Co. W. S. Townsend Engr., Greenville.

O., Athens—Will call bids in February or grading, paving an dcurbing, $5,000. C. C. Bibbee, Engr.

O., Dayton—Co. Covers contemplate street improvement. P. S. Bookwalter, Engr.

O., Painesville—City Council contemplates street improvement for next Spring.

O., Greenville—City Council contemplates street improvement.

O., Ubana—Plans being prepared to constr hard surf. rd.

O., Springfield—Resolution passed to proceed with paving program, $261,768 for this Spring.

O., Elyria—Co. Covers Loraine Co. consider constr of boulevard to parallel Lake Shore tracks. 32 ft. wide bridge will span Sheffield ditch.

O., Canton—Petition submitted to repair Cleveland Ave.

O., Wapakoneta—State Hgwy dept. appropriated $110,000 State Aid and approved co program for six miles of rd.

O., Cleveland—Co. Engr. will inspect roads for paving.

O., Tiffue—Delegation of Co. farmers petition Co. Covers to permit paving contracts not to exceed $20,000 which will eliminate brick road constr.

O., Celina—State support asured for Celina—Watash Rd $93,000, Wane Hgwy $30,000 and reservoirs Rd $10,000.

O., Columbia—State Hgwy Dept will pave Unity—Petersberg Rd $70,000 brick, 18 in. 1.34 mi.

Pa., Wilkinsberg—Boro Council contemplates grading, paving and grading and curbing.

Pa., Uniontown—Co Covers contemplates road inmprovement.

Pa., Scranton—Plans being prepared for street paving, $24,637. W. C. S. Schunke, Engr.

W. Va., Fairmount—City contemplates street paving various streets.

W. Va., Moundsville—Bids being called for road improvement.

W. Va., Bridgeport—Town Co. contemplate street paving, $37,000.

Wis., Hartford—City Council selected Jerry Donahue, Engr. 608 W. 8th St. Shedoygan for paving.

Wis., Mayville—Plans being prepared for paving in German St.

SEWERAGE AND SANITATION

Ia., Esterville—Co contemplates drains No. 152, 154, 150 and 151.

Ia., Emmentsberg—Polo Alto Co. contemplates constr drains.

Ia., Spencer—Plans prepared for drain No. 46 and 86.

Ill., Downers Grove—Plans being prepared for constr sewer in Spring.

Ill., Chicago heights—Plans being prepared for sanitary sewers, $68,000.

Ill., Naperville—Bd of local in.p contemplate sewers and drain constr.

Ill., Beardstone—Plans prepared for drainage and power plants, $175,000.

Minn., Dear River—Plans being prepared for sewer systems.

O., Athens—City contemplates storm sewer, $30,000.

Wis., Milwaukee—Preliminary plans for intercepting sewers being made.

Wis. Kenosha—Bids being called for sewer constr.

Wis., Marshfield—Plans being for sewers in various streets. Will call bids soon

Wis., Appleton—Bids being called early in January for const sewers.

Wis., Brillion—Plans being prepared for sanitary sewer and water works.

WATER SUPPLY

Ill., Hinsdale—Plans prepared for water mains, $75,000. Will mature Jan. Endwine Engr., 2047 Ogden Ave. Chicago.

Ill., River Forest—Plans prepared for water mains. R. F. Williams, Engr.

Ill., Naperville—Contemplate private water system at Country Club. $30,000.

Minn., Cloquet—Plans being completed for 2 reservoir covers. $$10,000.

O., Milan—Plans being prepared for water supply reservoir to cost $25,000.

O. Newark—City contemplates water filterature plant. $225,000.

Pa., Ebensburg—Na plans started for reservoir. Will mature in Spring.

Va., Yorktown—Plans prepared for reservoir for U. S. Govt.

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  - Sullivan Mchy. Co.
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  - Mandt Body Co.
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  - Acme Road Mach. Co.
  - Austin-Western Road Mchy. Co.
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  - Jaeger Mch. Co., The
  - Servicised Products Co.
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  - Russell Grader Mfg. Co.
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  - Russell Grader Mfg. Co.
  - Stockland Road Mach. Co.
- **Road Drags**
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  - Russell Grader Mfg. Co.
  - Stockland Road Mach. Co.
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